InScript Firmware

User Manual
Version 6.0.1-RL.20240904.1343

Read carefully before using.
Retain for future reference.

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Before contacting us for assistance, please review appropriate sections in this manual that may answer your questions. After consulting the manual, please submit a request through our website: https://novantaphotonics.com/technical-support-request-form-header/

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1.1 Transform2D

The Transform2D job node is a combination of the geometrical operators rotate, scale, slant and offset. It executes the geometrical operators in the order Scale → Slant → Rotate → Offset.

TIP

If you want to execute the geometrical operators in a different order then manually insert other Transform2D nodes with corresponding operators in the desired order into the tree structure in the Navigator window.

The order of transformations is crucial to the result.

Example: Start with a set of 2 transformations. A 45° counter-clockwise rotation about the origin around the Z-axis, and a translation down the X-axis. Suppose that the object you are drawing is small compared with the translation - so that you can see the effect of the translation - and that it is originally located at the origin. If you rotate the object first and then translate it then the rotated object appears on the X-axis. But if you translate it down the X-axis first and then rotate about the origin then the object is on the X = Y line, because of the 45° rotation. In general, the transformation path is critical. If you do transformation A and then transformation B then, in general, you get a different result as if you do it vice versa.

Offset Offsets the content of the Transform2D subnodes.

- **X** Sets the offset in X-direction.
- **Y** Sets the offset in Y-direction.

Scale Scales the content of the Transform2D subnodes in size.

- **X** Scales the size in X-direction.
- **Y** Scales the size in Y-direction.
- **Proportional** If this is activated then scaling in X- and Y-direction is done proportionally and thus only the X value needs to be entered.

Slant Slants the content of the Transform2D subnodes.

- **X** Slants the content along the X-axis. The effect is dependent on the Y value.
- **Y** Slants the content along the Y-axis. The effect is dependent on the X value.

Rotate Rotates the content of the Transform2D subnodes.

- **Angle** Rotates the content around the center of the coordinate system.

1.2 Transform3D

Use the Transform3D job node when using a 3D scan head.

The Transform3D job node is a combination of the geometrical operators offset, scale and rotate. It executes the geometrical operators in the order Angle (rotate) → Scale → Offset.

TIP

If you want to execute the geometrical operators in a different order then manually insert other Transform3D nodes with corresponding operators in the desired order into the tree structure in the Navigator window.

The order of transformations is crucial to the result. Here the same considerations apply as for the Transform2D job node; see there for an example.

To get the desired result while using the node it is best to modify and check at first the Angle then the Scaling and the Offset at last. With this approach it is easier to verify each step of the transformation in the Vector Editor.

Offset Offsets the content of the Transform3D subnodes.

- **X** Sets the offset in X-direction.
- **Y** Sets the offset in Y-direction.
- **Z** Sets the offset in Z-direction.

Scale Scales the content of the Transform3D subnodes in size.

- **X** Scales the size in X-direction.
- **Y** Scales the size in Y-direction.
- **Z** Scales the size in Z-direction.

Angle Rotates the content of the Transform3D subnodes.

- **X** Rotates around the X-axis.
- **Y** Rotates around the Y-axis.
- **Z** Rotates around the Z-axis.

2 Job nodes: Drawing

2.1 Circular Text

This node outputs text aligned to circular or elliptical arcs.

2.1.1 Tab Text

Edits the text, sets the horizontal alignment and the font.

Text field Enter the text here. If the text is too long for the arc then the text will be compressed. Text after a manual line break will superpose the first line.

Font Sets the font and its height.

Name Selects the font.

Size Sets the font height.

Text Sets the text alignment

Alignment Selects the alignment within an angular range on the ellipse. The angular range is specified in tab Angles. This parameter takes only effect if there is more space on the angular range then needed for the text.

Left Aligns the text to the left.

Center Aligns the text to the center.

Right Aligns the text to the right.

Block (Space) Justifies the text by stretching the space characters. The text itself remains unchanged.

Block (Scale) Justifies the text by stretching the all characters including the space characters. The ratio of text and space characters remains unchanged.

2.1.2 Tab Characters

Sets options for the characters.

Width Sets the character width. If on the Text tab Alignment is set to Block (scale) then setting Width has no effect.

Additional Spacing Sets the additional distance between characters. This does not include space characters.

Baseline Selects whether the base line, the center line or ascender shall be aligned to the arc.

Bottom Aligns the base line to the arc.

Center Aligns the center line to the arc.

Top Aligns the ascender to the arc.

Rotate If this is enabled then the characters will be perpendicular to the arc line. If this is disabled then the characters will be perpendicular to the X-axis.

2.1.3 Tab Ellipse

Defines the ellipse to which the text shall be aligned.

Width Sets the width of the ellipse.

Height Sets the height of the ellipse.

Flatness Sets the distance from the center to either focus of the ellipse divided by the distance from the center to either vertex or Flatness.

Show ellipse Visualizes the corresponding ellipse within the vecoreditor. This ellipse is not part of the output.

2.1.4 Tab Angles

Defines where and in which direction the text shall be aligned to the arc line. The angle of 0° is in +X-direction. Angles are measured counterclockwise.

Start Sets the angle at the arc, where the text begins.

Stop Sets the angle at the arc, where the text ends.

Direction Selects the text direction. This setting effects whether the text is oriented outward or inward the arc line. In order to maintain the text position on the arc when modifying the direction, swap the values of Start and Stop.

Clockwise Sets the text clockwise from Start to Stop.

Counterclockwise Sets the text counterclockwise from Start to Stop.

TIP

Creating an Ellipse node of same size and position as defined in the Ellipse tab could be helpful in understanding the effect of parameters on the Angles tab.

2.2 Concentric Circles

This node outputs Concentric Circles. The circles are enclosed by an inner and an outer circle. Including these circles a given number of equidistant circles is distributed in between. Furthermore the execution order and the shape of the circles can be modified.

Layout Specification Selects by which parameters the concentric circles are specified in the Layout group. Whichever list item is selected, parameters are deactivated and calculated automatically in the Layout group.

Radius1, Radius2, Circles Sets the inner radius, outer radius and the number of circles.

Radius1, Step, Circles Sets the inner radius, step size between radii and the number of circles.

Radius2, Step, Circles Sets the outer radius, step size between radii and the number of circles.

Radius1, Radius2 → Step Sets the inner radius, outer radius and the number of steps. Here the number of steps is subordinated to the other both parameters and will be automatically fitted, if not set according to these parameters.

Radius1, Step → Radius2 Sets the inner radius, number of steps and the outer radius. Here the outer radius is subordinated to the other both parameters and will be automatically fitted, if not set according to these parameters.

Radius2, Step → Radius1 Sets the outer radius, number of steps and the inner radius. Here the inner radius is subordinated to the other both parameters and will be automatically fitted, if not set according to these parameters.

Layout Defines the number and size of the circles.

Radius 1 Sets the radius of the inner circle.

Radius 2 Sets the radius of the outer circle.

Step Sets the step size in radius between 2 adjacent circles.

Circles Sets the number of circles.

Start Selects the circle the output shall begin with.

Small The output shall begin with the smallest circle.

Large The output shall begin with the largest circle.

Interleave Defines the execution order.

Type Modifies the skipping in execution order of the circles. Specify the boundary value in Value.

Linear Only each N-th circle will be processed.

Bit-reverse The circles will be output in a pattern which will maintain a minimal distance during the passes.

Value If the number of passes (N) is greater than 1 then the circles are not output back-to-back, but N−1 circles will be skipped. Skipped circles will be processed in later passes. This may be reasonable, if the processed material is sensitive to heat and needs time to cool down before being heated up again in a nearby area. Here is an example: With Circles = 8, Passes = 3 and Type = Linear the output order is 1-4-7-2-5-8-3-6.

Approximation The circles are approximated by polygons.

Mode Selects the boundary condition for these polygons. Specify the boundary value in Value.

Segments per 360° Sets the number of segments in the polygon.

Segment length limit Sets the length limit for the segments in the polygon.

Deviation limit Sets the deviation limit from the circular shape.

Value Sets the boundary value of the condition defined in Mode.

Line handling Defines whether the line handling shall be optimized.

Optimize If this is enabled then InScript arranges the start of a circle relative to the end of the previous circle in a way that a fluent motion results.

2.3 Dot

The Dot node generates a single dot for output. Use this node e.g. for percussion drilling of holes.

Origin Positions the dot within the scan field.

X coordinate Sets the X coordinate of the dot.

Y coordinate Sets the Y coordinate of the dot.

Time Defines a specific timing behavior that differs from the default timing that is defined in a pen, e.g. in Pens → default (systempen) → linepar → Times tab → Dot group.

Use specific time settings If this is enabled then the values in group Time are used instead of the values from a pen.

Pre delay Sets the laser beam On delay. This is the time that is waited for after a jump and before the laser is switched on. The Pre delay is needed for the X/Y-mirrors in the scan head to stop moving. In general this time is longer than for other line types because the speed has to be completely reduced to zero and not to a processing speed.

On time Sets the time where the laser beam is switched on at dot position, i.e. the exposure time.

Post delay Sets the laser beam Off delay. This is similar to the Pre delay but after exposure. As the tracking error with a stationary processing on a fixed position is zero, contrary to other line types, no negative values can be set here.

2.4 Ellipse

The Ellipse node generates an ellipse for output. Additionally the ellipse can be modified, e.g. to output only an elliptical curve.

Layout Defines the ellipse and its position within the scan field. The graphical object Ellipse is defined within a bounding box.

Origin Selects the point of origin of the bounding box, i.e. the point to which coordinates and geometrical operations are referring. The Center, Center point of the bounding box is pre-selected. Thus the bounding box center is at position (X coordinate, Y coordinate).

Absolute If this is enabled then the point of origin of the bounding box is always set to its Bottom, Left. Thus the bounding box center is at position (X coordinate + Width / 2, Y coordinate + Height / 2).

X coordinate Sets the X coordinate of the origin.

Y coordinate Sets the Y coordinate of the origin.

Width Sets the Width of the bounding box.

Height Sets the Height of the bounding box.

Number of segments Sets the number of segments for the approximation of the ellipse. Greater numbers improve the approximation but also increase the output time.

Modification Modifies the ellipse.

Start angle Sets the start angle of the elliptical curve, where the start angle of 0° is in X direction from the bounding box center. The angle is measured counterclockwise.

Total angle Sets the angle for that the elliptical curve will be generated, e.g. 90° generate a quarter of the ellipse.

Direction Selects whether the ellipse will be generated counterclockwise or clockwise beginning at the Start angle.

Draw radii If this is enabled then the start and endpoint of the elliptical curve will be connected both to the center point.

Draw chord If this is enabled then the start and endpoint of the elliptical curve will be connected.

2.5 Hatch

The Hatch node fills graphical objects with a hatching pattern.

TIP

To apply the hatching pattern to graphical objects, place them as subnodes of the Hatch node in the Navigator window.

To view the Hatch node's subnodes without hatching pattern in the Vector Editor window, set Execution mode to Neutral.

General Sets general hatching pattern properties.

X Sets the X-coordinate of the first hatch line's reference point. With X = 0 and Y = 0 the first hatch line passes through the origin of the filled object.

Y Sets the Y-coordinate of the first hatch line's reference point. With X = 0 and Y = 0 the first hatch line passes through the origin of the filled object.

Delta Sets the distance between the hatch lines.

Reduction Sets the scan distance between the contour and the hatching lines.

Mode Selects the hatch mode.

Single Sets a simple hatching pattern with the angle defined in Angle 1.

Cross Sets a cross-hatching pattern with the angles defined in Angle 1 and Angle 2.

Multi Sets multiple hatching pattern with starting angle Angle 1. All following hatches will be rotated by angle Multi delta as many times as specified in Multi number.

Offset Sets a hatching pattern, which consists of equidistant and ”concentric” inner contours in regard to the outer contour.

Angle 1 Sets the angle of hatching pattern 1.

Angle 2 Sets the angle of hatching pattern 2, if Cross is selected in Mode.

Multi delta See Mode, list item Multi.

Multi number See Mode, list item Multi.

Interleave Interleave settings for the hatchin pattern.

Mode Selects the interleave mode.

Linear Every n-th hatch line will be output. Enter the value for n in Passes.

Bit-reverse The hatch lines will be output in a pattern which will maintain a minimal distance during the passes.

Passes If Passes is greater than 1 then the hatch lines will not be output successively. Hatch lines will be skipped and output in later passes. This may be useful, when processing heat sensitive material that needs time to cool down before heating it up again near the first heating up.

Options Sets miscellaneous processing options.

Hatching If this is activated then the graphical child nodes will be hatched.

Outline If this is activated then an outline will be drawn.

Outline first If this is activated then the outline will be drawn before the graphical subnodes will be hatched. Outline has to be activated to use this option.

Bidirectional If this is activated then the hatch lines will be output bidirectionally. This increases the velocity but decreases the quality. If the head-, tail-, on- and off-delays are not set correctly in device linepar (line parameter) then output errors will occur.

2.6 Line

The Line node generates a line for output.

Layout Defines the line and its position within the scan field. The graphical object Line is defined within a bounding box.

Origin Selects the point of origin of the bounding box, i.e. the point to which coordinates and geometrical operations are referring. The Center, Center point of the bounding box is pre-selected. Thus the bounding box center is at position (X coordinate, Y coordinate).

Absolute If this is enabled then the point of origin of the bounding box is always set to its Bottom, Left. Thus the bounding box center is at position (X coordinate + Width / 2, Y coordinate + Height / 2).

X coordinate Sets the X coordinate of the origin.

Y coordinate Sets the Y coordinate of the origin.

Width Sets the Width of the bounding box, i.e. the X component of the line length.

Height Sets the Height of the bounding box, i.e. the Y component of the line length.

2.7 RawLines

2.7.1 Introduction

The RawLines node is a special and powerful job node. It can mainly be regarded as a container for line data. The RawLines node can embed line data of various file types into a job, like ARGES Raw Line (∗.arl), Scalable Vector Graphics (∗.svg), HPGL (∗.hpgl, ∗.plt) and AutoCAD Exchange Format (∗.dxf) or it can create line data from its subnodes. The RawLines node can also export line data from its subnodes to some of the mentioned file types.

Beyond that the RawLines node can accelerate job file operations, like loading and saving, and more importantly job execution itself. How is that done?

Other job nodes that do laser output - like Rectangle, Ellipse and Text, but not Group or Script - generate and thus calculate temporary line data from their parameters during job execution. Then this line data is being send to the output pipeline of the controller.

In contrast the RawLines node does not generate or calculate line data during job execution. It already contains the line data that can be send directly to the output pipeline of the controller at this time. But first the line data has to be generated somehow. To do so either import line data into the RawLines node or create line data from its subnodes. Find both procedures described below.

TIP

> If your job contains a large number of static job nodes then we strongly recommend to convert these static job nodes to predefined line data by using the RawLines node. A good example is a filled company logo that is unlikely to change and calculating the logo's filling each time during job execution would be inefficient.

Finally the RawLines node allows editing the line data it contains. This can be done either by editing the line data in the RawLines node's Node Properties or interactively in the Vector Editor. Find these procedures also described below.

2.7.2 Overview of functions

The most important functions of the RawLines node are available via its context menu in the Navigator window as well as via the table's context menu in its Node Properties window. These functions are:

- Load vectorgraphics
- Save to vectorgraphics
- Create from subnodes

As mentioned above, editing the raw lines data is possible in 2 different ways:

- by editing the raw lines data in the table in the RawLines node's Node Properties window
- interactively in the Vector Editor window

2.7.3 Importing line data

Procedure

1. In the Navigator view, open the RawLines node's context menu.
2. Click **Load vectorgraphics**, select an `*.arl`, `*.svg`, `*.hpgl` or `*.dxf` file and click **Open**.

   – OR –

   Drag and drop an `*.arl`, `*.svg`, `*.hpgl` or `*.dxf` file from the file system on the RawLines node in the Navigator view.

   In both cases the Memory used for the line data on the ASC system controller is shown in the Node Properties view.

2.7.4 Creating line data from subnodes

If you want to export line data from graphical job nodes to a vector graphics file then creating line data from subnodes is a preparatory step to do so.

Procedure

1. In the Navigator view, place graphical job nodes as subnodes of the RawLines node.
2. Open the RawLines node's context menu and click **Create from subnodes**.

   – OR –

   In the Node Properties view, click **Create from sub nodes**.

   In both cases the Memory used for the line data on the ASC system controller is shown in the Node Properties view.

   TIP

   Remove the RawLines node's subnodes either by deleting them or better moving them to a separate job, in case you will need them later on, e.g. for correction of line data.

2.7.5 Saving line data to a vector graphic

It is indicated that the RawLines node already contains some line data either imported or created from subnodes.

Procedure

1. In the Navigator view, open the RawLines node's context menu.
2. Click **Save to vectorgraphics** and select as File type `*.arl` or `*.svg`.
3. Name the file.
4. Click **Save**.

2.7.6 Clearing line data from the RawLines node

Procedure

- In the Node Properties view of the RawLines node, click **Clear**.

  The line data will be cleared fro the RawLines node. This does not apply to eventually present subnodes of the RawLines node.

2.7.7 Editing line data in the Node Editor

The Node Editor of the RawLines node allows editing the line data directly.

For this purpose a table with data of the single vertices is displayed.

Each line contains the following information (left to right):

- The vertex number
- The vertex type (LineStart, LineJoin, LineEnd or Dot)
- The X value of the vertex in mm
- The Y value of the vertex in mm
- The Z value of the vertex in mm
- The Pen Id of the vertex

Procedure

The X, Y, Z and Pen Id values can be edited in the respective columns. To edit a value:

1. Select the desired cell.
2. Press the **Enter** key.

   -OR-

   Double click the cell.
3. Edit the value.
4. Press the **Enter** key to enter the value and to edit the next cell in the column.

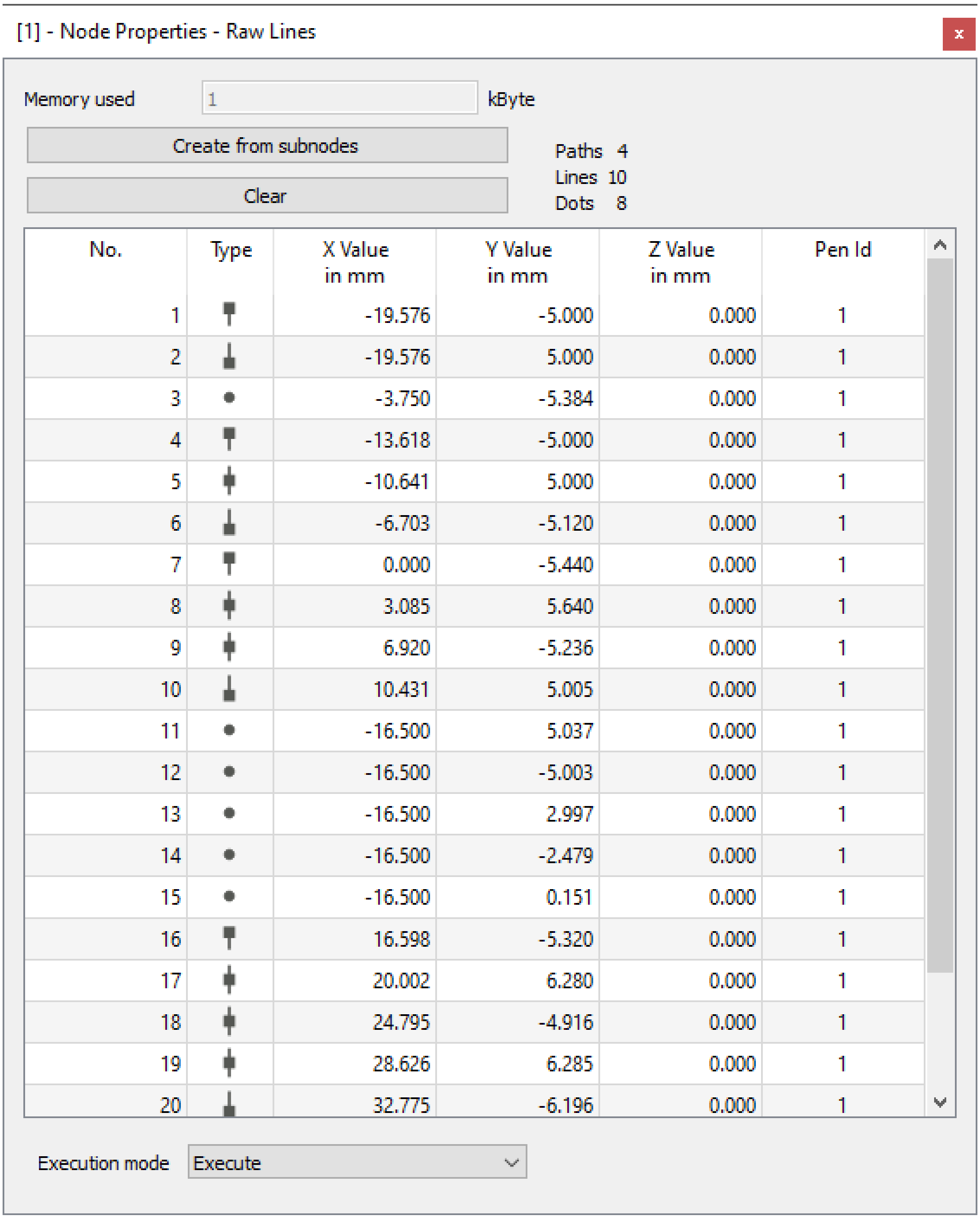
   -OR-

   Press the **Tab** key to enter the value and to edit the next cell in the line.

Additional functions are available in the table’s context menu. This is a small subset of the possibilities the Vector Editor provides.

2.7.8 Editing line data in the Vector Editor

For more information about how the line data of a RawLines node can be edited interactively see the InScript 3 User Manual, chapter ”Working With The Vector Editor View”, section ”Editing RawLines Nodes” (file: InScript_-<version>_manual_en.pdf).



No.	Type	X Value in mm	Y Value in mm	Z Value in mm	Pen Id
1		-19.576	-5.000	0.000	1
2		-19.576	5.000	0.000	1
3		-3.750	-5.384	0.000	1
4		-13.618	-5.000	0.000	1
5		-10.641	5.000	0.000	1
6		-6.703	-5.120	0.000	1
7		0.000	-5.440	0.000	1
8		3.085	5.640	0.000	1
9		6.920	-5.236	0.000	1
10		10.431	5.005	0.000	1
11		-16.500	5.037	0.000	1
12		-16.500	-5.003	0.000	1
13		-16.500	2.997	0.000	1
14		-16.500	-2.479	0.000	1
15		-16.500	0.151	0.000	1
16		16.598	-5.320	0.000	1
17		20.002	6.280	0.000	1
18		24.795	-4.916	0.000	1
19		28.626	6.285	0.000	1
20		32.775	-6.196	0.000	1

Figure 2.1: RawLines job node - NodeProperties Dialog

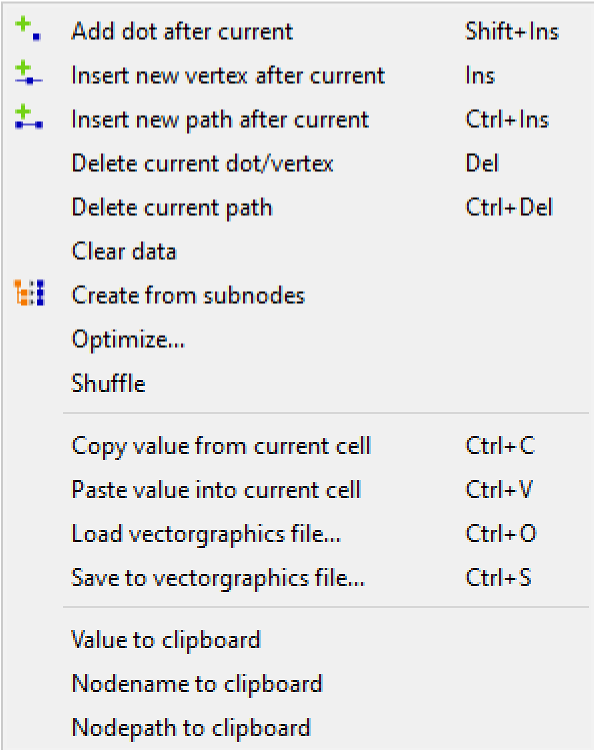


Figure 2.2: RawLines job node - Context menu of the NodeProperties

2.8 Rectangle

The Rectangle node generates a rectangle for output. Additionally the rectangle corners can be rounded.

Layout Defines the rectangle and its position within the scan field. The graphical object Rectangle is defined within a bounding box.

Origin Selects the point of origin of the bounding box, i.e. the point to which coordinates and geometrical operations are referring. The Center, Center point of the bounding box is pre-selected. Thus the bounding box center is at position (X coordinate, Y coordinate).

Absolute If this is enabled then the point of origin of the bounding box is always set to its Bottom, Left. Thus the bounding box center is at position (X coordinate + Width / 2, Y coordinate + Height / 2).

X coordinate Sets the X coordinate of the origin.

Y coordinate Sets the Y coordinate of the origin.

Width Sets the Width of the bounding box, i.e. the width of the rectangle.

Height Sets the Height of the bounding box, i.e. the height of the rectangle.

Round corners Defines the corners of the rectangle.

Radius If Radius is greater than zero then the corners are replaced by approximations of quarter circles. Thus the straight part of the rectangle's side is shortened by 2 $*$ Radius.

Number of segments Sets the number of segments for the approximation of a quarter circle at each corner. Greater numbers improve the approximation but also increase the output time.

2.9 Regular Polygon

The Polygon node generates a polygon for output. The polygon can have a convex or a convex/concave outline.

General Set the general geometry of the polygon.

Type Selects the polygon type.

Polygon Outputs a polygon with N convex vertices.

Star Outputs a polygon with N convex and N concave vertices.

Vertices Sets the number (N) of convex veritces.

Angles Defines the rotation of the polygon.

Start Sets the angle, where the first convex vertex occurs. The angle of 0° is in X direction from the polygon center. The angle is measured counterclockwise.

Offset Sets the offset from the regular angles of the concave vertices. At an angle of 0° the concave vertices are on their regular positions. The angle is measured counterclockwise.

Convex Sets parameters for the convex vertices (outer corners) for both types, Polygon and Star.

Radius Sets the outer radius on which the convex vertices will be located.

Corner Radius Sets the corner radius.

Corner Segments Sets the number of segments for the approximation of the corner curve. Greater numbers improve the approximation but also increase the output time.

Concave Sets parameters for the concave vertices (inner corners) for type Star.

Radius Sets the inner radius on which the concave vertices will be located.

Corner Radius Sets the corner radius.

Corner Segments Sets the number of segments for the approximation of the corner curve. Greater numbers improve the approximation but also increase the output time.

TIP

Invalid combinations of Radius and Corner radius for Convex and Concave induce errors or warnings. View the polygon in the Vector Editor.

2.10 ScannerDiag

NOTICE

This node should only be used by experienced users. Contact ARGES Support if you have further questions about this node.

NOTICE

This documentation is still in draft status.

With this node, the actuator positions of the scanhead galvos can be manipulated directly. The actuator positions can be set independently for each subframe (subframe 0 to subframe 7).

duration Duration of the output actuator positions in ms.

laserOn The laser gate signal is switched on during execution of the job node when this variable is set to TRUE.

sf0 to sf7 Actuator position settings for each subframe 0 to 7.

range Sets the maximum range of the subframe. Value is only valid when mode ”Specified”, ”- 100%” or ”+ 100%” is used.

value Sets the desired actuator coordinate value for the subframe. Value is only valid when mode ”Specified” is used.

mode Sets the operation mode for the subframe. The following settings can be used:

1. Undefined: The actuator coordinate for the subframe is not changed by the job node. The last value is used.
2. Specified: The actuator coordinate for the subframe is set to the result of the multiplication of the ”range” value by the ”value” value. This can also be used to set percentage values: Divide the desired ”range” variable by 100, set it to the result and set the ”value” variable to a value of 0 to 100%.
3. Zero: The actuator coordinate for the subframe is set to zero.

4. - 100%: The actuator coordinate for the subframe is set to the negative value of the defined range.
5. + 100%: The actuator coordinate for the subframe is set to the positive value of the defined range.

2.11 Text

This node can be used to enter text and format its output. The text can be slanted, scaled and distorted.

Font Sets the font properties.

- **Font** Selects the font.
- **Size** Sets the character height.
- **Slant** Slants the text. The slant angle results from the arc tangent of the entered value.

Spacing Sets the spacing between characters and lines.

- **Char spacing** Sets the spacing between characters. The unit is em, which is a unit in the field typography, equal to the currently specified point size.
- **Line spacing** Sets the lines height.
- **Mode** Selects whether Line spacing is given in relative or absolute values.
  - **Relative (%)** The values are given relatively to single tracking and single line height.
  - **Absolute** The values are given in absolute values.

Text Sets characteristics of the given text.

- **Alignment** Sets the horizontal alignment.
  - **Left** Aligns the text to the left.
  - **Center** Aligns the text to the center.
  - **Right** Aligns the text to the right.
  - **Block** Justifies the text by stretching the space characters. The text itself remains unchanged.
- **Encoding** Selects the encoding.
  - **Native 8 bit** Set this, if you want to edit or copy and paste text in ASCII format.

UTF-8 Set this, if you want to edit or copy and paste text in UTF-8 or UNICODE format. The program from which the text is being copied must support the UTF-8 or UNICODE format. The Font that is set in the Text node has to support all glyphs, i.e. characters, as well.

UTF-8 is the 8-bit UCS/Unicode Transformation Format. It is able to represent any character in the Unicode standard like Asian, Cyrillic or other non-latin characters, yet is backwards compatible with the limited ASCII format.

Layout Sets the text layout within a bounding box.

Origin Selects the bounding box point of origin to which coordinates and geometrical operations are referring.

Width Sets the bounding box width.

Height Sets the bounding box height.

Auto Width If this is activated then overlong text lines will be compressed to Width.

Auto Height If this is activated then the bounding box height will be automatically adjusted to the text height.

Auto Wrap If this is activated then the text automatically wraps regarding the bounding box but without stretching or compressing the text.

3 Job nodes: Organizing

Job

Counter

Delay

Group

3.1 Job

The Job node combines its subtree to an executable unit with a name. A job can be saved and loaded again. Its file name extension is `job`.

3.1.1 Tab General

File path Shows the file path and name when the job has been saved.

User interface If an user interface for the job exists then it is displayed here.

3.1.2 Tab Description

In this tab enter a description of what the job does. The ARGES system controller will display this text.

3.1.3 Tab On loaded

In this tab enter a script that shall be executed as soon as the job has been loaded. Find the scripting language described in the Script node.

3.1.4 Tab On selected

In this tab enter a script that shall be executed as soon as the job has been selected. Find the scripting language described in the Script node.

3.2 Counter

The Counter node sets and modifies numerical and alpha-numerical variables.

Variable Sets the variable name, that shall be modified. Enter the variable name without the $-characters.

Value Sets the value, that shall be assigned to the variable.

Mode Selects how the Value shall be assigned to the Variable.

- **Set string** Assigns the Value as a string to an alpha-numerical variable, e.g. STRING, TEXT.
- **Set value** Assigns the numerical Value to a numerical variable, e.g. INT32, REAL64.
- **Add value** Adds the Value to a numerical variable or even to an alpha-numerical variable. Example: A STRING variable ”000-000-999” will be updated to ”000-001-000” after Add value with Value 1 has been executed. Any alphabetic characters may be inserted before, between or after the numerical values.

3.3 Delay

The Delay node inserts a defined delay in the job structure.

Delay Sets the delay.

3.4 Group

This node combines its subtrees to one node. That way a collection of subtrees can be linked to (see Link), saved or executed if necessary. Also execution units under nodes can be combined for scripting (e.g. exec_subtree()) or ExtSelect nodes (see ExtSelect).

4 Job nodes: Repeating

4.1 Loop

The Loop jobnode is for executing its subtree repeatedly.

Loop count Repeats the subnodes Loop count times and stops then.

Endless If enabled the subnodes will be executed endless.

4.2 Repeat Along Path

The Repeat Along Path node outputs graphical objects at specified positions. These positions are managed in a list. The node contains exactly 2 child nodes, the Draw and the Align node.

When the Repeat Along Path node is executed, the content of the Draw branch is output at all listed positions. To produce an output the Draw node has to contain graphical child nodes.

By means of the Align node new positions can be generated along a path or already existing positions can be aligned to a path. Usage of the Align function and of the Align node respectively is optional.

Conversion Parameters:

Position Distance Sets the distance between positions to be created along the alignment path.

Fixed If the check box is selected then the distance between the positions is fixed and must not be varied by the algorithm.

Position distance minimal Sets the minimal distance between the positions.

Quiet zone start Sets the length of the quiet zone at the start of the alignment path. The quiet zone will not be converted into positions by the algorithm.

Quiet zone end Sets the length of the quiet zone at the end of the alignment path. The quiet zone will not be converted into positions by the algorithm.

Position at ends If this check box is selected then positions will be forced at the start and end of an open alignment path.

Positions in corners If this check box is selected then positions will be forced at the corners of an alignment path.

Corner angle If Positions in corners is selected then Corner Angle sets the minimal angle to create a position.

4.3 Repeat Circular

Using this node you can arrange output around a circle. The node divides a circle into positions and alignments. Then it outputs a subtree at these positions. If the node has several subtrees then these subtrees will be output after their sequence and distributed to the positions until all positions are taken.

Details Detail settings.

- **Radius** Sets the radius of the circle on which the objects are positioned.
- **Offset** Sets the start angle for the first position. A positive angle rotates counterclockwise. A negative angle rotates clockwise.
- **Divisor** Sets the number of positions distributed on the circle.
- **Direction** Selects the direction the objects are distributed with.
  - **counterclockwise** Distributes the objects counterclockwise.
  - **clockwise** Distributes the objects clockwise.

Object Rotation Object rotation settings.

- **Type** Selects whether the objects shall be rotated.
  - **objects upright** All objects stay upright.
  - **objects rotated** The objects are rotated around the circle.
- **Offset** The offset can only be set, if objects rotated is selected. The offset sets the angle applied to the objects additional to rotation. A positive angle rotates counterclockwise. A negative angle rotates clockwise.

4.4 Repeat XY

With this node, positions of output nodes can be arranged in a matrix of columns and rows. This is a fast and optimized method to output graphical elements, text or the output of any node in defined rows and columns.

Geometry Geometry settings for the output matrix.

- **Offset X** Sets the offset for the first matrix element in X direction.
- **Offset Y** Sets the offset for the first matrix element in Y direction.
- **Delta X** Sets the column distance in X direction.
- **Delta Y** Sets the row distance in Y direction.
- **Number X** Sets the number of columns.
- **Number Y** Sets the number of rows.

Options Positions the matrix within the scanfield and defines the order of execution of of the matrix.

- **Origin** Defines which element of the matrix is within the origin of the scanfield.
- **Primary axis** Defines if the matrix elements are executed row by row or column by column.
- **Bidirectionality** If the check box is selected then the matrix output will be bidirectionally. If it is cleared then the columns or rows will always be output in one direction.
- **Even line offset** Along the Primary axis x or y the elements of an even row or column will be shiftes by the given offset.

5 Job nodes: Advanced

Barcode

Barcode 2D

Pen Map

Script

Spiral

Use Pen

WFI

OnTheFly

SendRS232Command

Flush

Spline

Split Text

Precession Drill

Cutting Edge

External select

5.1 Barcode

Using the Barcode node different barcode types can be created.

Barcode Generates the barcode itself.

Type Selects the barcode type.

Code 39 also known as ”USS Code 39”, ”Code 3/9”, ”Code 3 of 9”, "USD-3", "Alpha39" or "Type 39" is a barcode symbology that can encode uppercase letters (A through Z), digits (0 through 9) and a handful of special characters like the $ sign.

Code 93 is a barcode symbology designed in 1982 by Intermec to provide a higher density and data security enhancement to Code 39. It is an alphanumeric, variable length symbology.

Code 128 is a very high-density barcode symbology. It is used for alphanumeric or numeric-only barcodes. It can encode all 128 characters of ASCII and, by use of an extension character (FNC4), the Latin-1 characters defined in ISO/IEC 8859-1.

Code 2/5 interleaved is a continuous two-width barcode symbology encoding digits.

Codabar is a linear barcode symbology. The body of a Codabar string may only encode the numerals 0 through 9. Some variants allow the symbols dollar, dash, plus sign, colon, slash, and dot.

EAN 13 European Article Number (EAN) is a barcoding standard which is a superset of the original 12-digit Universal Product Code (UPC). In EAN-13 the symbol encodes 13 numerals divided into four parts.

EAN 8 is a shortened version of the EAN-13 code. It includes a 2 or 3 digit country code, 4 or 5 data digits (depending on the length of the country code), and a checksum digit.

UPC A UPC-A barcode consists of two bars and two spaces, all UPC-A barcodes consist of exactly $(3 \times 2) + (12 \times 2) = 30$ bars.

UPC E To allow the use of UPC barcodes on smaller packages where a full 12-digit barcode may not fit, a 'zero-compressed' version of UPC was developed called UPC-E.

Content Type in the text or variable to be output into this text box.

- To use a variable it has to be embedded in 2 $-characters, e.g. the variable $stat.time.DateStr$ will output the current date.
- If you want to output the $-character then it has to be preceded

by the \-character, thus you have to type in \$.

- If you edit a job file directly via a text editor then the $-character has to be preceded by 2 \-characters, thus you have to type in \\$.

Layout Sets the layout.

Origin The graphical object is within a bounding box. In the Origin group you select the bounding box point of origin to which coordinates and geometrical operations are referring. In the Origin group the center point is pre-selected. Thus the bounding box center is at the coordinates X1/Y1. If e.g. the right lower radio button is selected then the right lower corner is at the coordinates X1/Y1.

Offset x Sets the reference point X position.

Offset y Sets the reference point Y position.

Width Sets the width of the barcode depending on Width Mode.

Height Sets height of the the barcode.

Width Mode Selects to what the Width refers.

Width Width refers to the whole barcode.

Module width Width refers to one barcode module (i.e. the width of a ”bar”).

Auto width If this check box is selected then the bounding box’ width will be automatically adjusted to the width of the barcode.

Auto height If this check box is selected then the bounding box’ height will be automatically adjusted to the height of the barcode.

Options Sets options for the barcode.

Outline If the check box is selected then the barcode modules will be outlined.

Fill If the check box is selected then the barcode modules will be filled.

Bidirectional fill If the check box is selected then the barcode modules will be bidirectionally filled.

Fixed fill If the check box is selected then the distance between the filling lines will be strictly adhered to. Thus the module width may differ from the nominal value and some barcode scanners may have problems to read the barcode. If the check box is cleared then the outlines confining the module will be set exactly. Thus the readability is increased for barcode scanners. The distance between filling lines may differ from the nominal value, so that visible gray scales occur on certain materials.

Draw ASCII If the check box is selected then the ASCII characters from the Content box will be output beneath the barcode.

Fill ASCII If the check box is selected then the ASCII characters from the Content box will be filled.

Checksum If the check box is selected then the checksum will be coded into the modules. Only specific barcode types provide this option.

Mark Bright Select this check box, if the material becomes brighter marking it.

Font Sets the barcode's font.

Name Selects a font from a dropdown list. All installed customer specific fonts are displayed and can be used. The fonts are located in the Fonts folder of the InScript installation.

Size Sets the character height.

Misc Changes miscellaneous settings.

Spot Size Sets the real physical spot size on the target.

Width reduction Reduces the width of barcode modules by the input value to compensate for the line width on the target.

Width factor Some Barcode types provide modules in exactly 2 widths (narrow and wide). Width factor sets the ratio of narrow and wide modules. With a factor of 2.000 the wide modules are twice as wide as the narrow modules.

Quiet Zone X Sets the width in X-direction of the area, where no marking will be output around the barcode.

Quiet Zone Y Sets the height in Y-direction of the area, where no marking will be output around the barcode.

5.2 Barcode 2D

This node creates 2D barcodes in different encodings.

Barcode Generates the barcode itself.

Type Selects the 2D barcode type.

DataMatrix Version may 8, 1997 / ISO 16022; Error Correction Code 200 is supported.

Content Type in the text or variable to be output into this text box.

- To use a variable it has to be embedded in 2 $-characters, e.g. the variable $stat.time.DateStr$ will output the current date.
- If you want to output the $-character then it has to be preceded by the \-character, thus you have to type in \$.
- If you edit a job file directly via a text editor then the $-character has to be preceded by 2 \-characters, thus you have to type in \\$.

Encoding Options Sets options for barcode encoding.

Encoding Selects the encoding according to ISO 16022.

ASCII is used to encode data that mainly contains ASCII characters (0-127). It encodes approximately one alphanumeric or two numeric characters per byte. As a general rule, use ASCII to encode text that includes uppercase and lowercase letters with or without numbers and punctuation.

C40 is used to encode data that contains only numeric and upper case characters. C40 encodes approximately three alphanumeric data characters into two bytes.

Text is used to encode data that mainly contains numeric and lowercase characters. Text encodes approximately three alphanumeric data characters into two bytes.

Base 256 is used to encode images, double-byte characters, binary data and 8 bit values.

None no encoding is used.

Auto tries to automatically choose an encoding.

Format Selects the encoding format.

nXm Sets the number of cells per line and the number of lines in the barcode.

Auto Automatically selects the format to encode the information given in Text with the smallest possible format.

Format warning If the check box is selected and you enter an information which can not be encoded then a warning will be output.

Output Options Sets miscellaneous output options.

Fillmode Selects the way the 2D barcode cells will be filled.

Cell Lines Fills the barcode cells with horizontal lines. The distance between the lines is specified in Spot Size. The lines will be output unidirectionally from the left to the right.

Cell Lines Bidi As Cell Lines, but bidirectionally, i.e. the lines will be output alternating from the left to the right and vice versa.

Cell Lines Bidi Cont As Cell Lines Bidi, but the end of a line will be connected to the start of the next line by a vertical line. A kind of sinuous line develops.

Cell Dot Outputs a dot in the barcode cell center.

Cell Dot Array Quad Fills the barcode cell horizontally and vertically with n times n dots. The number n results from the Spot Size setting and the cell size.

Cell Dot Array Hex As Cell Dot Array Quad, but the dots of successive lines will be shifted against each other and a kind of honeycomb pattern develops.

Cell Subnodes Fills each barcode cell with the object which is child node of the Barcode 2D node.

Scanline unidirectional Fills the barcode cells with scanlines in one direction.

Mark Polarity Specifies, how the color of the material changes after marking.

Bright The material darkens.

Dark The material brightens.

Include quiet zone If the check box is selected then a margin around the 2D barcode stays unmarked. This margin takes 10% of barcode width and height.

Disable quiet zone If the check box is selected then the whole width and height will be used for the 2D barcode.

Size Sets options for the barcode's size.

Spot Size Specifies the real physical spot size on the target. The spot size can not be set this way, but is specified so InScript can perform calculations. If Cell Lines, Cell Lines Bidi, Cell Lines Bidi Cont, Cell Dot Array Quad or Cell Dot Array Hex are selected in Fill Mode then the dot density can be modified by changing the Spot Size. At 50micrometer 20 dots per mm will be output, at 100micrometer only 10 dots per mm will be output.

Width Sets the 2D barcode width.

Height Sets the 2D barcode height.

Origin The graphical object is within a bounding box. In the Origin group you select the bounding box point of origin to which coordinates and geometrical operations are referring. In the Origin group the center point is pre-selected. Thus the bounding box center is at the coordinates X1/Y1. If e.g. the right lower radio button is selected then the right lower corner is at the coordinates X1/Y1.

5.3 Pen Map

With this node pen numbers can be assigned to pens (sets of parameters). Pen numbers are used e.g. in HPGL-files. In that way pens can be selected during a job via the content of e.g. HPGL-files. By dragging & dropping pens from the Pens group they can be assigned to pen numbers in the Pen Set group. Pens can be selected from the Pens folder (on the hard disk e.g. from the C:\nProgram \FilesnInScript\Pensfolder) or pens from the controller board (in the Job Configuration window in the Pens folder). If the Job reaches this node on its execution pen numbers from 1 to maximal 32 are assigned to the pens defined in the pen folder on the controller board. When a Pen Set node is reached during the execution of a job then the parameters will be set to the values which are defined in the pens at the moment.

Pen X Name Selects the name of a pen that is stored on the controller board. The pen link is set to this pen. There are X different pens available.

Upload before execution If this check box is selected then the pen will be loaded from the PC to the controller board directly before execution of the Pen Link node. If the pen was already loaded to the controller board then the pen on the controller board will be overwritten. If the pen does not exist on the PC then the pen on the controller board will persist.

5.4 Script

To implement complex programs with specific functions InScript offers an internal scripting language

In the Script node such scripts can be input and conditions for their execution can be set.

TIP

The scripting language is case-sensitive.
It is vital that each command is terminated by a semicolon.

5.4.1 Scripting Language

The InScript controller scripting language resembles the syntax and semantics of the programming language C. Unlike in C the object types are not determined until runtime. Furthermore the parameter values of functions have no strict type. Like in C Script formatting, like e.g. line breaks or line indents only improve readability and have no effect on execution.

Data Objects Terms can consist of constants, variables, function calls and their combinations. Constants can be strings, numbers or logical values (true, false).

String Constants string constants are character strings which are enclosed in double quotes (e.g. ”This is a string”). It is possible to insert certain ASCII control characters by escape sequences with a leading backslash:

Escape-Sequence	ASCII-Code	decimal	Character
\a	ASCII BEL	07	bell
\b	ASCII BS	08	backspace
\f	ASCII FF	12	form feed
\n	ASCII LF	10	line feed
\r	ASCII CR	13	carriage return
\t	ASCII HT	09	horizontal tab
\v	ASCII VT	09	vertical tab
\”	”	34	quotation marks
\?	?	63	question mark
\0	ASCII NULL	00	null
\\	\	92	backslash

Numerical Constants numerical constants can be integer (in a range from -2147483648 to +2147483647) or floating point values (in a range from ±1038) and are notated e.g. as 3.141593 or 3.8e10 or 1e10.

Variables can have the following properties: **name, value, unit (e.g. mm, degree, sec), type, flags** Variables do not have to be declared. They will be automatically created. The type results from the assigned value. But the user can also declare variables, e.g. in $usr.var.$, in two ways. On the one hand they can be declared in the Xplorer and on the other hand in a Script. To access a variable the variable name is enclosed in two $ (e.g. $sys.Board-Name$ or $usr.job.TestJob.Text..text$).

In InScript variables are arranged in a hierarchical tree structure which is reflected in the variable names and in the job tree structure.

Please note, that variables of a node are combined in a sub folder of this node. As nodes can contain further child nodes, this is more clearly arranged. As this sub folder is nameless, two dots are previous to the variable name in the address.

You can address variables by their absolute names. In the above example this is $usr.job.JobXYZ.Rotate..angle$. If you are using variables in scripts then we strongly recommend to address variables by their relative names.

TIP

If the variable name is given without an explicit path then InScript assumes the variable as user defined and located in the branch usr.var.

Types Variables can have different Types. Possible types are:

Type	Value	Example
boolean	binary value true or false	true
int	integer 32 Bit	64738
long (not usable for constants)	integer 64 Bit	2047413647
float	IEEE 754 floating-point no. 32 Bit	3.141593
double (not usable for constants)	IEEE 754 floating-point no. 64 Bit	123.12345
string	sequence of Bytes	”This is a string”

TIP

The types long and double may be used but it is not possible to define constants with this types. That is, constant values (like e.g. 100 or 123.456) always are of type int or float in InScript.

Type conversion (type casting) within a term is automatically carried out, but can also be forced. Here is an example:

```
$var$ = (2+3.1) + (string)(3+4) + ”xyz”;
```

2 and 3.1 are added, the ”smaller” type is expanded, i.e. 2 (int) becomes 2.0 (float), then 2.0 and 3.1 are add together, the result is 5.1 (float). 3 (int) and 4 (int) are add together to 7 (int) and then converted into the string ”7” (string). Due to analysis order 5.1 (float) is converted to ”5.1” (string) and ’add together’ with ”7” (string), i.e. the strings are joined. The result ”5.17” (string) is joined with ”xyz” (string). Finally the value ”5.17xyz” (string) is assigned to the variable var.

Flags each variable can have a set of flags that control its behavior. Possible flags are:

5.4.2 Operators

5.4.3 Functions

TIP

Not all functions are available in all firmware versions. Older firmware versions may only provide a subset of these functions.

Definition of own functions is not possible with the momentarily available version. But a lot of internal functions are available:

Graphical functions Graphical script functions.

commit_pen_stack() Commits the pen stack and forces pen change.

draw_line(x1,y1,x2,y2) Draws a line from <x1>/<y1> to <x2>/<y2> (<xn> and <yn> in millimeters).

previewing() Returns true, if the controller is in preview mode; otherwise false.

set_clip_rect() Applies the values of ”Field Size” and ”Field Offset” to the global clipping rectangle. After the function was called it is valid for all job nodes. Then dots and lines can be output only within the specified rectangle.

set_clip_rect(x1,y1,x2,y2) Applies the specified values to the global clipping rectangle. After the function was called it is valid for all job nodes. Then dots and lines can be output only within the specified rectangle.

String functions String manipulating functions.

strlen(str) Provides the number of characters in the passed string.

```
// strlen example
$lenstr$ = ”One two two three ”;
$num$ = strlen($lenstr$); // $num$ == 17
```

strndup(str,omit,n) Provides a part of string <str> with length <n>, where <omit> characters will be omitted out at the beginning of <str>.

```
// strndup example
$str$ = ”One two two three ”;
$substr$ = strndup($str$ ,4,7); // $substr$ == ”two two”
```

chr(chr) Provides a string containing ASCII character chr.

```
// chr example
$str$ = chr (65); // $str$ == ”A”
```

asc(str) Returns the ASCII code of the first character of string <str>.

```
// asc example
$num$ = asc(”A”); // $num$ == 65
```

strpos(str1,str2) Returns the first occurence (0 based) of <str2> in <str1> or -1 if <str2> is not found.

```
// strpos example
$posstr$ = ”One two two three ”;
$num$ = strpos($posstr$ , ”two”); // $num$ == 4
```

strrpos(str1,str2) Returns the first occurence (0 based) of <str2> in <str1> searched from the back or -1 if <str2> is not found.

```
// strrpos example
$posstr$ = ”One two two three ”;
$num$ = strrpos($posstr$ , ”two”); // $num$ == 8
```

strtok(str,strdelim,n) Returns information about a substring in <str> between characters in <strdelim> (<n>=0: return number of tokens <n>=1:return first substring <n>=-1:return last substring).

strtok(str,strdelim) Returns number of substrings in <str> between characters in <strdelim>.

```
// strtok example
$tokstr$ = ”token1.token2 ,token3 ”;
$str$ = strtok($tokstr$ , ”.,”, 1); // $str$ == ”token1”
$num$ = strtok($tokstr$ , ”.,”, 0); // $num$ == 3
$str$ = strtok($tokstr$ , ”.,”, -1); // $str$ == ”token3”
$num$ = strtok($tokstr$ , ”.,”); // $num$ == 3
```

Processing functions Function for job processing.

mark_start() Starts execution of a selected job.

mark_stop() Sets the ”stop” flag to stop at a specific point (i.e. at a Stop node in the job).

mark_abort() Aborts a running job.

wait4marking() Waits until the system is in state ”processing”.

wait4ready() Waits until the ”System Activity State” device (SASP) is in state ”ready” (e.g. when values were changed in the default pen and the changes are executed).

purge() Causes the scan head to completely output buffered vector data; after this, the function returns.

idle() Distributes computing time to other processes (e.g. in waiting loops).

msleep(t) Delays further execution for the given time <t> (in milliseconds), the computing time is distributed to other processes.

info_dlg(value) Outputs a simple information window showing the ”<value>” in brackets.

```
// info_dlg example
$i$ = 10;
$str_hw$ = ”Hello World ”;

// dialog with ”Hello World !”
info_dlg (”\”” + $str_hw$ + ”!””);

// dialog with i=10
info_dlg (”i=” + $i$);

// in this example the dialog with i=10 will show ABOVE
// the dialog with ”Hello World !” because it executed
// after it
```

subtrees() Returns the number of sub nodes of the Script node.

exec_subtree(n) Executes the <n>th sub node of the Script node, counting starts at 0.

exec_subtree(name) Executes the subtree <name>

(e.g. exec_subtree(Transform); if you have a subtree

usr.job.Script.Transform) below the script node.

disable_abort() After calling this function, abort (viz. ms_break) is disabled.

enable_abort() After calling this function, abort (viz. ms_break) is (re-)enabled.

HostExec(prg,arg) Calls executable <prg> with argument <arg> on host.

ms_break() Returns true if job is aborted or false otherwise (useful in connection with disable_abort(),enable_abort()).

clock() Returns a value in seconds.

```
// clock example
$time1$ = clock ();
msleep (2000); // sleep 2 seconds
$time2$ = clock ();

$timeelapsed$ = $time2$ - $time1$;
// calculates elapsed time between time1 and time2
// this should be _around_ 2.000000 seconds
```

Math functions Miscellaneous mathematical functions.

random() Returns a pseudo-random 64-Bit integer value.

sin(f) Returns the sine of <f>.

cos(f) Returns the cosine of <f>.

sqrt(f) Returns the square root of <f>.

fabs(f) Returns the absolute value of <f>.

baseconv(v,base,d) Returns a string of value <v> to the numeral base of <base> with <d> digits (e.g. baseconv(255,16,8) results in 000000FF, which is the value 255 to the base 16 (hexadecimal) with 8 digits).

acos(f) Returns the arccosine of <f>.

asin(f) Returns the arcsine of <f>.

atan(f) Returns the arctangent of <f>.

atan2(f1, f2) Returns the arctangent of <f1>/<f2>.

exp(f) Returns the exponential function e raised to the power <f> (e is Euler’s constant).

log(f) Returns the natural logarithm of <f> (<f> has to be greater than 0).

log10(f) Returns the base-10 logarithm of <f> (<f> has to be greater than 0).

pow(f1,f2) Returns the number <f1> raised to the power <f2>.

tan(f) Returns the tangent of <f>.

Data management Data management functions.

remove_files() Removes all data objects in the ”Files” set.

create_node(name, type, flags) Creates a new node with properties <name>, <type> and <flags>.

```
// create_node example
create_node (”usr.var.x”, ”VAR:INT32”, ”NQ”);
```

delete_node(name) Tries to delete a node (variable, job, etc.) with the given <name>.

set_node_flags(name, flags) Sets the <flags> of a node with the given <name>.

set_minval(name, minval) Sets the minimal value for the variable <name> to <minval>.

set_maxval(name, maxval) Sets the maximal value for the varaible <name> to <maxval>.

node_exists(name) Returns true, if the node <name> exists, else false.

get(name) Gets the value of a node with the given <name> ($usr.var.-x$=get(”usr.var.y”) does the same as

$usr.var.x$=$usr.var.y$, but the <name> argument to get() can be constructed at run-time).

set(name, value) Sets the value <value> of a node with the given <name> (set(”usr.var.a”,123) does the same as $usr.var.a$=123, but the <name> argument to set() can be constructed at run-time).

DebugLog(str) Enter <str> to the Debug Log.

get_unit(name) Returns unit of variable <name>.

line_flush() Flushes the DSP line draw buffer (like purge in script node e.g. change external parameter (focus, axis etc.), draw line, flush, change external parameter (focus, axis etc.), draw line, flush etc.).

select_job(name) Select job <name> (e.g.

select_job("usr.job.MyJob");) could be used for variable

dbg.script_cmd as a "run once" (not usable in a conventional script because then system is processing).

test_node_flags(name,flags) Check if flags are set in <flags> of node <name>.

```
// test_node_flags example
if(test_node_flags ("usr.var.TEST","U") == true)
{
 info_dlg ("Flag U set !");
}
```

Input and output functions Input and output functions for communication.

serial_setup(port, bps, bits, parity, stop) Initializes interface <port> ("COM A" or "COM B") with the settings <bps> bits per second, <bits> data bits (7,8,9), <parity> (0=none 1=odd 2=even), <stop> stop bits (1,2).

```
// serial_setup example
serial_setup ("COM A", 9600, 8, 0, 1);
// COM A, 9600 bps , 8 data bits , no parity , 1 stop bit
```

send(port, string) Sends <string> via interface <port> ("COM A" or "COM B").

send_hex(port, string) Sends <string> via interface <port> ("COM A" or "COM B"), where <string> represents the bytes to be transmitted in hexadecimal notation receives a character from interface <port> and returns its value as INT32. If no character is available then -1 is returned.

```
// send_hex Example
serial_setup ("COM A", 9600, 8, 0, 1);
    // COM A, 9600 bps , 8 data bits , no parity , 1 stop bit
send_hex ("COM A", "48616 c6c6f0d0a ");
```

```
    // sends the charachters "Hallo <CR ><LF >" via interface
    // COM A
```

receive_byte(port) Receives a character from interface <port> and returns its value as INT32. If no character is available then -1 is returned.

```
$byte$ = receive_byte ("COM A"); // wait forever for a byte
```

receive(port, maxchars, delim, timeout) Receives data from interface <port> and returns received data as a string. Maximum <maxchars> characters will be receiced. If a character is received contained in string <delim> then receiving will also be stopped (this last character will not be returned). At the latest after <timeout> (in seconds) the function returns its result.

```
// wait 10 minutes (600 seconds) for 10 Bytes
$tenchars$ = receive ("COM A", 10, "", 600);
if(strlen($tenchars$) < 10) info_dlg (" Reply too
    short - timeout occured !");

// wait 10 minutes (600 seconds) for a maximum of
// 1024 Bytes until \n (newline) is sent
$string$ = receive ("COM A", 1024, "\n", 600);
```

TCP_Open(ip,port) Open TCP connection <ip> on <port>, returns handle to TCP connection.

TCP_Close(handle) Close TCP connection <handle> (returned by TC-P_Open).

TCP_Receive(handle,maxch,delim,timeout) Receives data from TCP handle and returns received data as a string. Maximum <maxchars> characters will be receivced. If a character is received contained in string <delim> then receiving will also be stopped (this last character will not be returned). At the latest after <timeout> (in seconds) the function returns its result.

```
// TCP_Receive Example
$handle$ = TCP_Open ("192.168.1.42" , 80);

TCP_Send($handle$ , "GET index.html\r\n");
$html$ = TCP_Receive($handle$ ,10 ,"" ,5);
    // wait 5 seconds for 10 Bytes

// see if 10 characters were received or if we had a timeout
if(strlen($html$) != 10) info_dlg ("A timeout occurred
```

```
        - received less than 10 chars !”);
    else info_dlg($html$);

    TCP_Close($handle$);
```

TCP_Send(handle,data) Send data <string> to TCP <handle> (returned by TCP_Open).

```
// TCP Example
$handle$ = TCP_Open (”192.168.1.227” , 80);
TCP_Send($handle$ , ”12345”);
TCP_Close($handle$);
```

5.4.4 Control Flow

A control flow statement is a statement whose execution results in a decision being made as to which of two or more control flows should be followed.

Simple statements are e.g. assignment of values or function calls. Each instruction of a statements is ended by a semicolon ”;”. Several instructions can be combined to a single statements by enclosing them into curly braces, e.g.:

```
$second$ = $second$ + 1;
if($second$ >= 60)
{
 $second$ = 0;
 $minute$ = $minute$ + 1;
}
```

statement a statement can be one or more scripting command. If there are more scripting commands, they may be grouped using curly braces { and } or have to be grouped if they are executed e.g. under an if statement:

```
command1
{
 command2
 command3
 command4
}
```

goto and labels a goto is a direct jump to a label:

```
goto label1;
whatever you like here - this code is skipped
label1; // goto jumps here
```

if is a conditional statement. The if statement has two forms:

```
if(expression) statement // if the expression after the if
is true statement is executed if
it is false statement is skipped
if(expression) statement1 // if the expression after the if
else statement2 // is true statement1 is executed
if the expression after the if
is false statement2 is executed
```

The structure can be as complicated as e.g. this:

```
if(expression){
  if(expression){
    statement(s)
  }
 }else{
   statement(s)
 }
```

while a while loop is a control flow statement that allows code to be executed repeatedly based on a given boolean expression:

```
while(expression)
statement // statement is executed while expression is true
expression normally is influenced in statement but
expression can also be a function that returns true
or false
```

do .. while occasionally it is profitable to guarantee at least one execution of the statement following while, so an alternative form exists:

```
do
statement // statement is executed while expression is true
(but at least once)
while(expression); // be aware of the semicolon after the while
```

for a for loop is a control flow statement which allows code to be repeatedly executed. A for loop is classified as an iteration statement because it normally uses an internal loop counter.

```
for (initialize; check; update) statement
initialize: e.g. $i$=0
check: e.g. $i$ < 10
update: e.g. $i$ += 2
```

break a break statement can be used to leave any loop before its expression is fulfilled or count has expired:

```
while(expression)
{
 statement
 break; // leave while loop even if expression is not false
}
for(initialize; check; update)
{
 statement
 break; // leave while loop even if check is not false
}
```

return a return statement exits a script

```
info_dlg (”This is shown !”);
return;
info_dlg (”This is NOT shown !”);
$x$ += 1; // not done
```

5.4.5 Scripting Examples

Please reference to these examples for a easier understanding of the scripting language.

Example: A variable usr.var.x of type INT32 is created and initialized with value 5. If the variable already exists then only the value is assigned.

```
$x$ = 5;
```

Example: The output o1 (dev.pio.o1) is set to true, then the input i1 (dev.-pio.i1) is waited for before output o1 is set to false.

```
$dev.pio.o1$ = true;
while (!$dev.pio.i1$)
```

```
idle();
$dev.pio.o1$ = false;
```

Example: The output o1 (dev.pio.o1) is set to 1 for 1 second.

```
$dev.pio.o1$ = 1;
msleep (1000);
$dev.pio.o1$ = 0;
```

Example: In the usr.var.x node the flag N is set (+) and the flag Q is cleared (-).

```
set_node_flags (”usr.var.x”, ”+N-Q”);
```

Example: How to create a random value between 4 and 10.

```
$n$ = 4; // low value
$m$ = 10; // high value

$num$ = $m$ - $n$ + 1; // get number of items
$rnd$ = random (); // randomize a number
if($rnd$ < 0) $rnd$ *= -1; // remove negative values

calculate numbers between $n$ and $m$
$rndnum$ = $rnd$ % $num$ + $n$;

info_dlg($rndnum$);
```

Example: To comment your scripts you have two possiblities:

```
// Several lines of
// comment

// one -line comment
```

Example: Each command line is terminated by a semicolon.

```
$strHelloWorld$ = ”Hello World ”;
info_dlg($strHelloWorld$);

info_dlg is also handy for debugging output!
```

Example: Possible scripting control flow:

```
$x$ = 5;
```

Example: A variable usr.var.x of type INT32 is created and initialized with value 5. If the variable already exists then only the value is assigned.

```
$x$ = 10;
$y$ = 10;

if($x$ == 10) $x$ = 20; // if equal
else
{
 $x$ = 15;
 $y$ = 5;
}

if($x$ != 10) // if not equal
{
 $x$ = 30;
 $y$ = 40;
}
else // else (in this case ”if equal ”)
$x$ = 5;

while($x$ <= 40) // while x is less than 40
{
 $x$ += 5; // this is the same as x% = x% + 5;
}

do
{
 $x$ = $x$ + 5;
}
while($x$ <= 50); // while x is less than 50

$x$ = 0;
while($x$ < 10)
{
 $x$ += 1;
 if($x$ == 5) break; // leave while($x$ < 10) loop
```

```
after its closing ”}”
}
info_dlg($x$); // $x$ is 5!

for($x$ =0;$x$ <10; $x$ +=1) // for i from 0 to 9
{
 $usr.job.Job.Script.Transform ..sx$ = $x$;
 exec_subtree (” Transform ”); // execute node ”Transform” below the
   script node
}
```

Example: Variables are automatically created if you use them, they have to be enclosed by 2 $- characters e.g.:

```
// creates the InScript variable usr.var.myVar
$myVar$ = 10;

// existing variables can also be used e.g.:
if($dev.sas.stat.marking$ == true) goto next;

next:
```

Example: Node variables. You may also use variables that represent node values e.g.: Copy the variable’s name to the clipboard and paste it in your script (be careful, if you move the node or rename a job, the variable name may change, so it is better to use relative variables):

```
$usr.job.Job.Shape ..x1$ // absolute variable
$<. Shape ..x1$ // relative variable
```

In the second example, you only need one ”<” because the Script node is in the same level as the Shape node (be careful, if you move the Script node to a different level it will still invalidate the variable).

Example: String variable arithmethic. For output or edit, variables of different type can be concatenated as strings by using a ’+’ character.

```
$strVar$ = ”It is ”;
$x$ = 1;
info_dlg (”[ Output #” + $x$ + ”] ” + $strVar$ + $stat.time.TimeStr$
    + ” o ’clock !”);
```

Example: Cast a variable. You can cast variables to different types, which may be handy if you want to format a number (e.g. int) as a string or use a string as a number. To do this you can use the cast operator (<type>). <type> can be e.g. string, int, long, float, double or boolean.

```
// string with 990 as three characters
$strVar$ = ”990”;

// intVar is the number 990
$intVar$ = (int)$strVar$;

// add 11
$intVar$ += 11;

// strVar is the string ”1001” with four characters
$strVar$ = (string)$intVar$;

// $len$ is 4
$len$ = strlen($strVar$);

info_dlg($strVar$ + ” is a ” + $len$ + ”-digit number !”);
```

Example: Execute a subtree below the Script node. To execute node elements from within Script nodes you are able to put a call to an exec_subtree function in your script code. Here is the Job Configuration view of a job that uses the script snippet below:

```
$usr.job.Script_exec_subtree_Example.Script.Transform ..sx$ = 0;
$usr.job.Script_exec_subtree_Example.Script.Transform ..sy$ = 0;
$usr.job.Script_exec_subtree_Example.Script.Transform .. angle$ = 0;

for($i$ =0;$i$ <=360; $i$ +=10)
{
 $usr.job.Script_exec_subtree_Example.Script.Transform ..sx$ = $i$ * 2;
 $usr.job.Script_exec_subtree_Example.Script.Transform ..sy$ = $i$ * 2;
 $usr.job.Script_exec_subtree_Example.Script.Transform .. angle$ = $i$;

 exec_subtree (” Transform ”);
}
```

Example: Check if a variable (or node because variables are also nodes) exists.

```
if(node_exists ("usr.var.DoIExist "))
{
Variable DoIExist exists in usr.var
 info_dlg ("usr.var.DoIExist exists !");
}
else
{
Variable DoIExist does not exist in usr.var
 info_dlg ("usr.var.DoIExist does not exist !");
}
```

Example: Output a text file from a Script. To output text into a file on the host PC you can use the HostExec script command in combination with the Windows shell command echo. The example shows a for loop that increments i from 0 to 9. These numbers and i ∗ 2 are output to the file C:nOutput.-txt.

```
HostExec ("C:\\ Windows \\ System32 \\cmd.exe", "/C echo Values: >
    C:\\ Output.txt");
for($i$ = 0; $i$ < 10; $i$ +=1)
{
 $y$=$i$ *2;
 HostExec ("C:\\ Windows \\ System32 \\cmd.exe", "/C echo i=" + $i$ + " i
  2= " + $y$ + " >> C:\\ Output.txt");
}
```

Description of the code lines:

```
// initialize the file Output.txt via Windows Shell command echo with
// first line "Values:"
HostExec ("C:\\ Windows \\ System32 \\cmd.exe", "/C echo Values: > C:\\
    Output.txt");
// repeat code in curly braces 10 times and increment $i$ from 0 to 9
for($i$ = 0; $i$ < 10; $i$ +=1)
// calculate $i$ * 2 for output in second column
$y$=$i$ *2;
// output $i$ 0…9 0…18 to the file Output.txt
HostExec ("C:\\ Windows \\ System32 \\cmd.exe", "/C echo i=" + $i$ + "
    i*2= " + $y$ + " >> C:\\ Output.txt");
```

Some Background: Using echo on a CMD.EXE command prompt to output text is used like this: echo Here is some text. The > pipe command redirects console program text output to a text file and >> appends to a text file. So this appends Hello to the text file TEXT.TXT: echo Hello >> TEXT.TXT

TIP

Do not put a number directly before the Windows Shell pipe commands > or >> (e.g. 0>>, which i + ”>>” would do) this will lead to output to e.g. stdout or sterr. Just put a space between the number and the pipe (e.g. 0 >>). Also be sure that e.g. no newline nn or similar characters are in the HostExec line because this would act like having a CMD.EXE line with these characters, which could lead to unwanted effects.

5.5 Spiral

This node creates spirals. Particularly when producing drill holes this node is useful. In this node a lead in can be defined to place the first pulse in an area outside the later function area. Trepanning cycles can be specified for the inner and outer radii of the spiral. By defining the phase angle e.g. laser specific roundness deviations can be compensated or oval shapes can be intentionally set.

General General spiral settings.

- **Mode** Determines the speed that will be held constant.
  - **Fixed Angular Speed** The spiral is output with constant angular speed.
  - **Fixed Linear Speed** The spiral is output with constant track speed.
- **Frequency** Sets the rotation frequency the spiral is output with.
- **Phase** Sets the spiral projection angle. At 0° the spiral is symmetrical, at 90° only a line is visible.
- **Rotation** Sets the projection axis angle referring to the XY coordinate system.
- **Start** Sets the start point angle referring to the XY coordinate system.
- **ON Delay** Sets the ON delay.
- **OFF Delay** Sets the OFF delay.
- **Direction** Selects the rotational direction of the spiral.
  - **clockwise** Clockwise rotation.
  - **counter-clockwise** Counter-clockwise rotation.

Radii Sets options for the radii.

- **Radius 1** Sets the spiral radius R1.
- **Revolutions(R1)** Sets the number of revolutions output with radius R1.
- **Radius 2** Sets the spiral radius R2.

Revolutions(R2) Sets the number of revolutions output with radius R2.

Revolutions (R1→R2) Sets the number of revolutions output between the radii R1 and R2.

Lead In If the check box Lead In is selected then an additional radius can be specified here.

Lead In (check box) Check box to activate Lead In input field.

Approximation Parameters for spiral approximation.

Mode Selects, how the spiral is approximated. This list is only active, if Fixed Linear Speed is selected in list Mode in group General.

Segments per 360° Number of segments per revolution. The value is set in Value.

Segment length limit Maximal segment length in mm. The value is set in Value.

Deviation limit Maximal segment deviation in mm from the spiral. The value is set in Value.

Value Sets the value regarding Mode.

5.6 Use Pen

This node refers to a pen in the Job Configuration window in the Pens folder. When a Pen Link node is reached during the execution of a job then the parameters will be set to the values which are defined in the pen at the moment. If several Pen Link nodes are referring to one and the same Pen then the memory required on the controller board does not multiply, because only links to already existing data are used.

Pen Name Selects the name of a pen that is stored on the controller board. The pen link is set to this pen.

Upload before execution If this check box is selected then the pen will be loaded from the PC to the controller board directly before execution of the Pen Link node. If the pen was already loaded to the controller board then the pen on the controller board will be overwritten. If the pen does not exist on the PC then the pen on the controller board will persist.

5.7 WFI

The WFI job node generates WFI A-Scans for its child job nodes. It is also used to generate dummy reads and to do a background calibration to eliminate noise.

5.7.1 Requirements

- To use the WFI job node you need a WFI device with an active measurement. Otherwise this job node has no effect.

5.7.2 Usage

5.7.2.1 Generating a dummy read

During a dummy read the processing laser will not be active. Only the WFI SLD will emit. The resulting A-Scan will not be displayed anywhere.

Procedure

1. In the WFI job node, set Trigger type to Dummy.
2. In the Navigator view, place a Dot job node as child of the WFI job node.

5.7.2.2 Eliminating noise via background calibration

During a background calibration the processing laser will not be active. Only the WFI SLD will emit. The resulting A-Scan will not be displayed anywhere but it will be used to subtract the noise information from the A-Scans.

This should be done at least once for each process.

Procedure

1. In the WFI job node, set Trigger type to Background.
2. In the Navigator view, place a Dot job node as child of the WFI job node.
3. Set the position of the Dot job node to a scanner position where the reflection of the WFI beam is at a minimum and no depth signal will be

acquired.

5.7.2.3 Generating a single A-Scan

Procedure

1. In the WFI job node, set Trigger type to Single.
2. In the Navigator view, place the desired job node as child of the WFI job node.

5.7.2.4 Measuring via WFI

Procedure

1. In the WFI job node, set Trigger type to Burst.
2. In the Navigator view, place the desired job nodes as children of the WFI job node.
3. In the WFI device on the Control tab, activate External trigger.
4. To start the WFI measurement click **Start**.

   This covers your job with a number of A-Scans. The result is shown in the Topology layer within the Vector Editor.

5.8 OnTheFly

In an On-the-Fly or Always-on On-the-Fly system, the OnTheFly job node and its subnodes define one job segment. The position origin of this node and its subnodes on the workpiece is defined by the position encoder resolution and the position encoder counter value in the ”cnt_offset” variable.

Please see the ”On the Fly” device documentation and the example jobs for reference.

pos_enc_device The name of the position encoder device instance this job node is associated with

cnt_offset The position encoder counter value at which processing of this segment shall start

off0_x X position offset (do not change)

off0_y Y position offset (do not change)

off0_z Z position offset (do not change)

5.9 SendRS232Command

With this node, RS232 commands can be sent to and the responses read from a connected RS232 serial device. At the moment there is no node properties dialog for this job node, so the job node has to be configured via the InScript inspector.

initialize Initialize the selected serial interface at begin of node execution.

close_on_exit Close the selected serial interface at end of node execution.

port Selection of serial interface (COM C, UART USB0, UART USB1...). If just one USB-to-RS232 converter is connected to the ASC, use ”UART USB0”.

baud Baud rate to set for the selected interface. Only valid if initialize is set to TRUE.

bits Number of data bits for the selected interface. Only valid if initialize is set to TRUE.

parity Parity setting for the selected interface. Only valid if initialize is set to TRUE.

stop Number of stop bits for the selected interface. Only valid if initialize is set to TRUE.

handshake Handshake selection (None, XON/OFF, RTS/CTS). Only valid if initialize is set to TRUE.

command The command to be sent out.

rsp_string (read only) The last received response.

rsp_timeout Timeout for the response in seconds.

rsp_max_chars Maximum number of response characters received.

rsp_term Termination characters for the response(\r, \n, ...).

rsp_warn List of responses which trigger a warning dialog.

rsp_abort List of responses which cause marking to be aborted.

All strings are represented using printable ASCII characters and space (ASCII 32). Characters which are not in this set are specified using the escape mechanism used in ANSI C (ISO/IEC 9899:1990) string constants.

5.10 Flush

The Flush node is closely associated with the Repeat node function. The Repeat node ”seamlessly” repeats its child nodes, i.e. without switching off the laser beam in between the repetitions. The Flush node forces the laser beam to switch off between repetitions. For this purpose place the Flush node beneath the node to be repeated.

Sequence of execution:

Job → Repeat → Laser on → Process Shape → Flush → Laser off → Repeat → Laser on → Process Shape → etc. until the Repeat is exhausted.

5.11 Spline

By this node spline curves can be created and output.

Curve type selects the curve type

- **B-Spline** the curve is of type B-Spline

End type selects what type of ends the curve has

- **Open** the curve begins at the second point defined and ends at the last but one point defined
- **Extended** the curve begins at the first point defined and ends at the last point defined
- **Closed** the curve is automatically closed between the last and the first point defined

Flatness the curve is approximated by a polygon. Depending on the number of polygon lines a deviation from the curve occur. This parameter sets the maximal allowed deviation from the curve

5.11.1 Creating a spline curve

Procedure

1. In the Job Configuration tree structure, create a **Spline** node.

   A Spline node is shown in the tree structure and in the Vector Editor window a blue Spline wild-card symbol is shown.

2. In the Spline node, optionally set any parameter (see above).
3. In the Vector Editor window, select the Spline wild-card symbol.

   The Spline wild-card symbol changes its color from blue to red.

4. Right click the Spline wild-card symbol and select **Handle Points**.

   The Spline wild-card symbol turns color from red to green.

5. In the Vector Editor window, double click the positions where the interpolation points for the spline curve shall be.

   A gray connecting line between points is drawn. This is an auxiliary line to see which points are successive.

6. If you double click any already set point, it will be removed.
7. If all points are set, right click the gray spline and select **Handle Objects**.

   The spline will turn from gray to blue.

   TIP

   You have to create at least 4 points to create the first spline curve.

5.11.2 Handling points of a spline curve

Procedure

1. In the Vector Editor window, select the spline curve.

   The spline curve turns color from blue to red.

2. Right click the spline and select **Handle Points**.

   The spline changes its color from red to gray.

3. To create a new end point, double click at the new position.

   The new point will become the last point defined.

   — OR —

   To create a new point between 2 existing points, double click the connecting auxiliary line between these 2 points.

   — OR —

   To move a points, Drag&Drop the point to its new position.

   — OR —

   To delete a point, select the point to be deleted and press the **Del** key.

   The point will be deleted after confirmation.

5.12 Split Text

By this node text can be divided into tiles. You can define the size, offset and overlap of these tiles.

That way e. g. curved objects can be processed rotating around an axis in the scan field or work pieces can be processed that are larger than the scan field.

TIP

In the Split tab, axes have to be selected, otherwise the text will not be displayed in the Vector Editor.

Split Text - Text Using this tab you can create and format text. The text can be slanted in different angles, scaled in width and height and distorted

- **Font Name** selects a font from a dropdown list
  - **Size** sets the character height
  - **Storage** selects what shall happen to the font after the text was output
    - **Keep** the font will be kept in the controller board memory
    - **Remove** the font will be removed from the controller board memory
  - **Slant** sets the text slant. The slant angle results from the arctan of the entered value. Values from +3 to 3 are allowed
- **Spacing Mode Relative** the values are given relative to single tracking and single line distance in %
    - **Absolute** the values are given absolute in mm
  - **Char Spacing** sets the distance between characters (tracking)
  - **Line Spacing** sets the distance between lines.
- **Text Alignment** Align the text to desired choice
- **Layout Origin** The graphical object is within a bounding box. In the Origin group you select the bounding box point of origin to which

coordinates and geometrical operations are referring

X sets the origin X coordinate

Y sets the origin Y coordinate

Width sets the bounding box' width

Height sets the bounding box' height

Auto Width if the check box is selected then the bounding box width will be automatically adjusted to the width of the longest line

Auto Height if the check box is selected then the bounding box height will be automatically adjusted to the text height

Auto Wrap if the check box is selected then the text will be automatically wrapped at the bounding box. If the check box is cleared then the text will be automatically condensed to fill the bounding box width

Split Text - Split In this tab you can divide the text into tiles, i. e. set their size, offset and overlap as well as set the axes to be moved after each tile has been output

Axes X, Y selects the axes and direction they will be moved

(+) axis forward direction (depending on the device)

(-) axis backward direction (depending on the device)

(→) The second list offers only axes which have a present and activated device driver. In this list axes can be assigned to the X and Y direction

Scan bidirectionally If the check box is selected then successive lines will be output in opposite direction

Primary axis selects the axis, the lines will be output with

X the X axis

Y the Y axis

Mode selects the mode, the tiles will be output with

Production show the tiles as they will be output. As the to be processed object is moving in the scan field, the tiles will be shown overlapped

Setup ”simulates” the movement of the axes and shows the tiles clearly arranged side by side

Radius provide the radius in mm

Offset **X** sets the tile offset in X direction

Y sets the tile offset in Y direction

Overlap **X** sets the tile overlap in X direction

Y sets the tile overlap in Y direction

Field Size **X** sets the tile size in X direction

Y sets the tile size in Y direction

5.13 Precession Drill

The Precession Elephant 2/3 allows the user to control both the position of the laser spot on a work piece as well as the beam incidence angle. For drilling processes, the beam incidence angle is also called the precession angle. Find an illustration of terms in figure 5.16 on page 90.

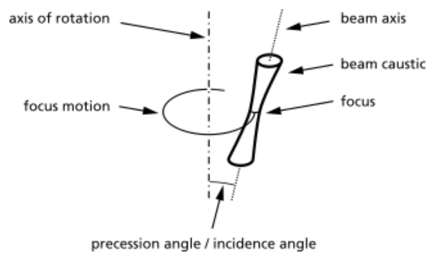


Figure 5.1: Terms

The scan head generates the desired motion of the beam focus and of the precession angle as a sequence of elementary motions. Each elementary motion is described by a defined set of parameters. Sequences of elementary motions then allow the user to generate circular, elliptical, spiral, helical or other focus motions, and to vary the precession angle.

The extremely flexible programming approach enables the user to drill holes with innovative geometries: it is possible to vary the shape, conicity and taper angle along the height of the hole.

Ellipses and spirals – 1st and 2nd axis In order to create circles, ellipses and spirals InScript combines a sinusoidal motion of the X-galvanometer with a cosinusoidal motion of the Y-galvanometer. Figure 5.2 on page 80 illustrates the motion achievable with 2 axes. To generate the planar focus motions, 4 parameters are needed for the 2 axes. These are the number of revolutions performed, the radius, and the 2 phases of the involved galvanometer motions.

Helices – 3rd axis In addition to the planar focus motions that trace out circles, ellipses and spirals, a superimposed variation of the Z-axis parameter, or focus shift, produces helical or conical focus motions with variable slope. Figure 5.3 on page 80 illustrates this.

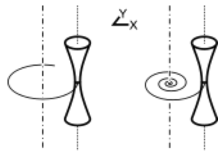


Figure 5.2: Ellipses and spirals

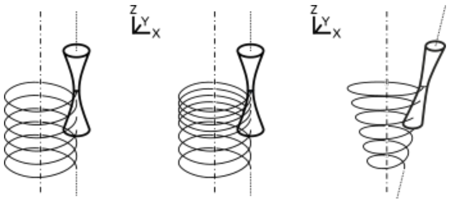


Figure 5.3: Helices

Precession – 4th and 5th axis The precession parameters allow the user to incline the laser beam. The inclination angle, or precession angle, can be varied along the motion of the focus. This enables the user to drill holes with negative taper or even with varying taper angles. Figure 5.4 on page 80 illustrates this. With the second generation objective lens, the focus always remains on the plane that contains the circular, elliptical, or spiral paths for all precession angles.

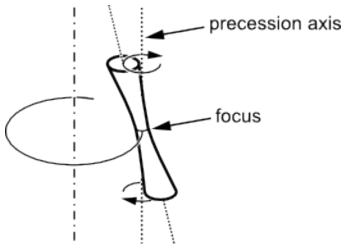


Figure 5.4: Precession

Beam attenuation and polarization control – opt. 6th, 7th, 8th axis The Precession Elephant 2/3 can be expanded with a beam attenuator and with a system that rotates and deforms the polarization ellipse. The beam attenuator is controlled in real time via the ASC. A unique feature development is the electronic setting of the beam polarization ellipse. Two axes set the orientation and the ellipticity of the compensating polarization ellipse, to ensure perfect circular polarization at the beam focus.

Compensation at higher precession drill frequencies

The following effect occurs with larger apertures of the scan head and the larger internal beam expansion factors.

The mass and thus the inertia of the Y-mirror is larger than of the X-mirror. This causes a phase shift between the sinusoidal and cosinusoidal rotary motion of the mirrors.

With small frequencies (typically $<$50 Hz), the phase shift is negligible small. With a circular control command a circle is processed.

By increasing the frequency continuously, the phase shift finally is not negligible any more. Instead of the circle an ellipse is processed, whose long axis shrinks and rotates around the center. Additionally the ellipse gets increasingly flatter. Figure 5.5 on page 81 illustrates this.

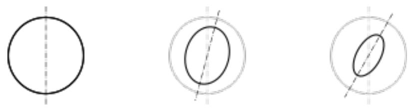


Figure 5.5: Uncompensated output (with frequency rising from left to right)

To process circles even with small radii and high frequencies you have to determine by experiment the compensating values for radius, phase and rotation. Figures 5.6 on page 81 and 5.7 on page 82 illustrate this. This is the first step you have to take before continuing to other shapes.

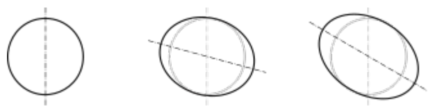


Figure 5.6: Compensating control command (with frequency rising from left to right)

With increasing frequency the described effect leads to a non-linear rise of the power dissipation in the galvanometers. To prevent the galvanometers' burn out a hardware and a software fuse exist. The hardware fuse can not be set. As software fuse a limit of the frequency is used. This limit is preset in a

Figure 5.7: Partially compensated output (with frequency rising from left to right); compensation of radius still due

way that with larger apertures the hardware fuse and with smaller apertures the software fuse responds. If your application demands it and you got a scan head with small aperture then the limit can be increased. If you wish to do this, please contact Novanta.

5.13.1 Requirements

Wobbling must be enabled. For how to enable wobbling see section Setting the wobbling (superimposing the laser beam trajectory with a circular movement).

The Linehandling mode in the linepar device must be set to Actuator LH.

5.13.2 Drilling strategy tab

This tab organizes the order of parameter sets for the precession drill. The interpolation can be parametrized on tab Advanced parameters but this is not recommended.

Description of figure 5.8 on page 83:

The table in the screenshot defines the states and their order.

- **(empty)** shows the state order number.
- **Number of revolutions** sets the number of revolutions it takes to interpolate linearly the current state from the previous state. Thus Number of revolutions and the Drilling Frequency on tab Parameters define the time of transition from the previous state to the current state. As there exists no previous state for state 1 the Number of revolutions always is 0 in state 1.

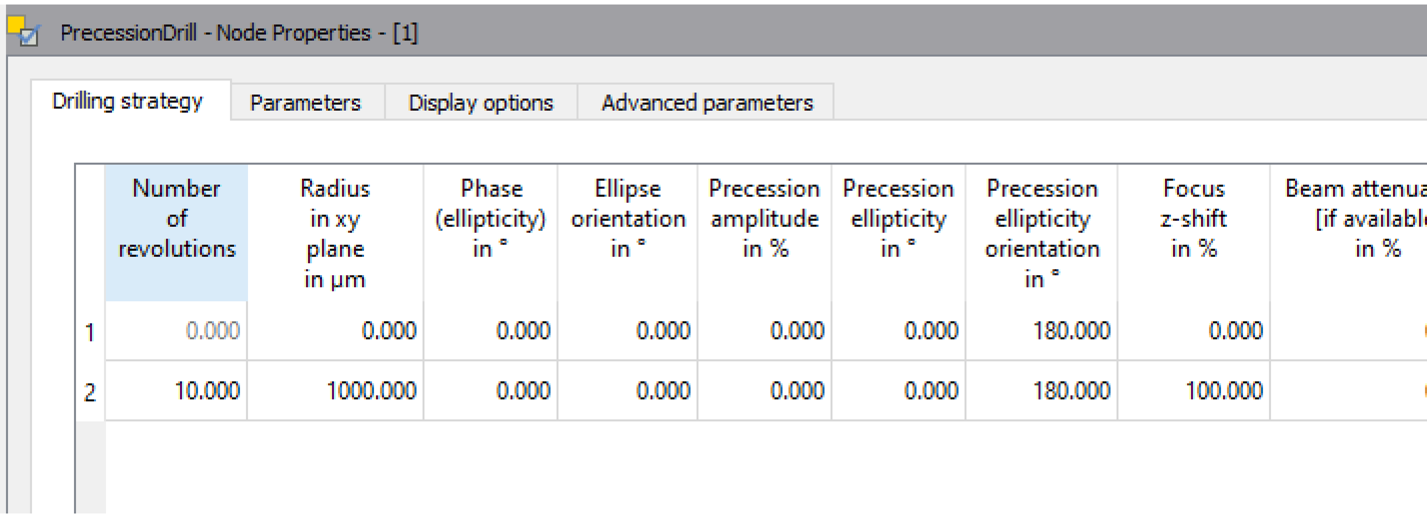


Figure 5.8: Precession Drill job node - Drilling strategy tab

Radius in xy plane in mm sets the drilling radius in xy plane, i.e. the amplitude of the sinusoidal and cosinusoidal rotary movement of the scan mirrors.

Phase (ellipticity) in ° sets the drilling ellipticity, i.e. the phase between the sinusoidal and cosinusoidal rotary movement of the scan mirrors. A phase of 0° results in a circle. A phase >0° and <90° results in a ellipse where ellipticity grows with increasing phase angle. The long axis of this ellipse lies at 45° between the x- and y-axis. A phase of 90° results in a line which lies at 45° between the x- and y-axis. Figure 5.9 on page 83 illustrates this.

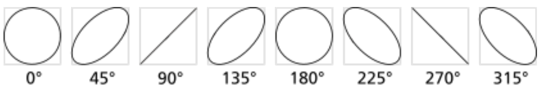


Figure 5.9: Phase (ellipticity)

Ellipse orientation in ° sets the ellipse orientation, i.e. the rotation around the center of the movement or in other words a phase shift between the frequency and the sinusoidal and cosinusoidal rotary movement of the mirrors simultaneously. Figure 5.10 on page 84 illustrates this.

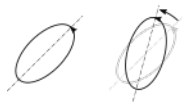


Figure 5.10: Ellipse orientation

Precession amplitude in % sets the radius of beam displacement. In combination with focusing optics this results in a precession angle on the target. You need a calibration curve which maps this radius to the resulting precession angle of the laser beam.

Precession ellipticity in ° sets the precession ellipticity. As both plates for beam displacement have the same inertia, so the problem with different inertias like with the X- and Y-mirror does not occur here. Therefore the radius of beam displacement, which is defined by the value of the Precession amplitude, will be constant even with higher frequencies. Nevertheless the Precession ellipticity is useful to obtain elliptical movements. For more information see parameter Phase (ellipticity).

Precession ellipticity orientation in ° sets the precession ellipticity orientation. As both plates for beam displacement have the same inertia, so the problem with different inertias like with the X- and Y-mirror does not occur here. Therefore the radius of beam displacement, which is defined by the Precession amplitude, will be constant even with higher frequencies. Nevertheless the Precession ellipticity orientation is useful to obtain elliptical movements. For more information see parameter Ellipse orientation.

There is a useful relation between the Ellipse orientation and Precession ellipticity orientation. The following figure 5.11 on page 85 illustrates this.

Focus z-shift in % sets the position of the focus translator. You need a calibration curve which maps the percentage position of the focus translator to the resulting position of the focus in Z-direction, e.g. in millimeters. As this curve is dependent on the optics used and as there is a high variety of combinations possible, determine the calibration curve by experiment, please. Note that scan field is

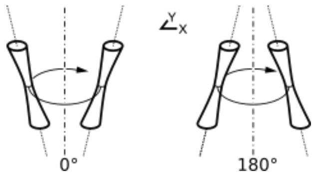


Figure 5.11: Phase shift between the ellipse orientation and precession ellipticity orientation

corrected only for one Z-position of the focus. A focus z-shift of 1 % is in the order of magnitude of 10 µm.

Beam attenuation [if available] in % sets the position of the attenuator. You need a calibration curve which maps the percentage position of the attenuator to the resulting attenuation of the laser beam, e.g. in Watt. Please determine the calibration curve by experiment.

You can organize the state order list with help of the following buttons:

- adds a state (line) to the list.
- removes the selected state from the list.
- moves the selected state 1 entry up in the list, i.e. decreases order number.
- moves the selected state 1 entry down in the list, i.e. increases order number.

5.13.3 Parameters tab

This tab sets general parameters for precession drilling.

TIP

Wobbling must be enabled. Enable the wobble function:

1. Edit the Head pen-section settings, see [1] chapter Working with Pens.
2. On the Wobble tab, set Type to circular.

Description of figure 5.12 on page 86:

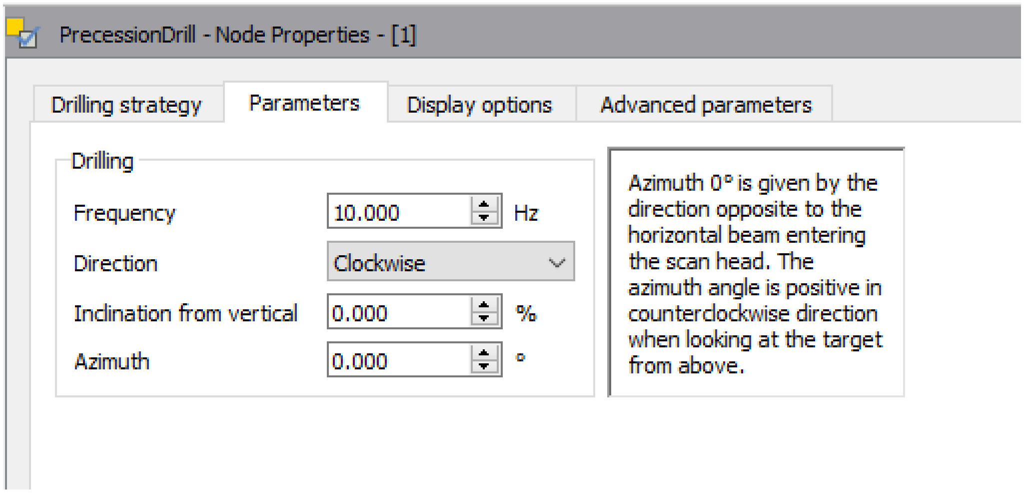


Figure 5.12: Precession Drill job node - Parameters tab

Drilling defines general parameters for precession drilling.

Frequency sets the rotary frequency of the precession drill.

Direction selects the rotary direction of the precession drill.

Clockwise sets the rotary direction to clockwise.

Counterclockwise sets the rotary direction to counterclockwise.

Inclination from vertical sets the beam inclination from vertical. Normally the precession axis is vertical orientated and the precession parameters change continuously the inclination angle of the beam axis. But the precession axis can be statically set to a specified position by inclination from vertical and azimuth where to add the wobble. The following figure 5.13 on page 86 illustrates this.

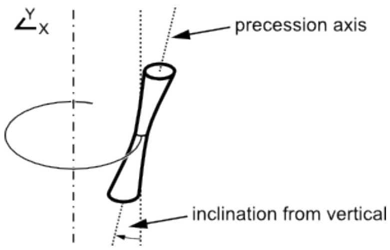


Figure 5.13: Static precession axis inclination for corrections

Azimuth sets the azimuth angle. It defines the orientation of the inclination from vertical within the XY plane. Azimuth 0° is given by the direction opposite to the horizontal beam entering the scan head. The azimuth angle is positive in counterclockwise direction when looking at the target from above.

5.13.4 Display options tab

This tab parametrizes the precession drilling related display options for the Vector Editor.

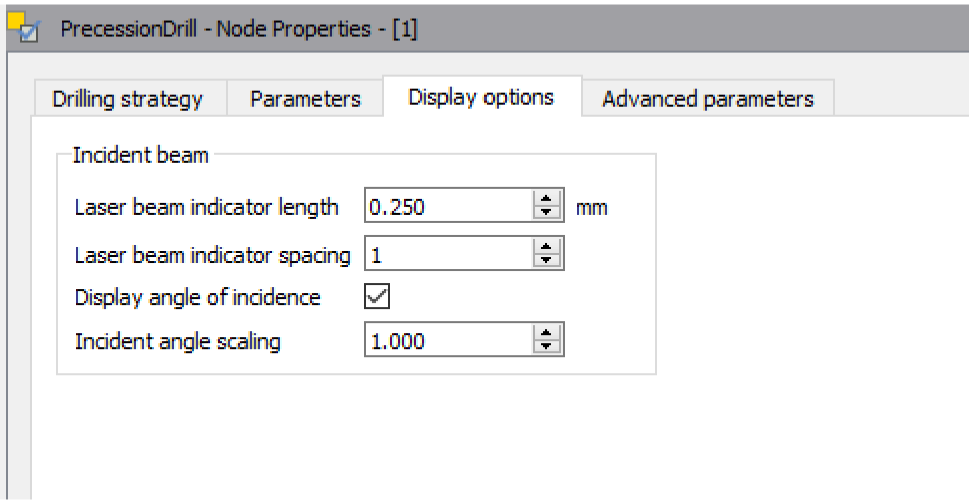


Figure 5.14: Precession Drill job node - Display options tab

Description of figure 5.14 on page 87:

Incident beam sets parameters for the precession drill simulation in the Vector Editor in 3D mode.

Laser beam indicator length sets the length of the laser beam indicator lines.

Laser beam indicator spacing sets the spacing between the laser beam indicator lines.

Display angle of incidence shows, if checked, the angle of incidence.

Incident angle scaling sets the factor by which the incident angle can be exaggerated, if it is too small to be visible.

5.13.5 Advanced parameters tab

This tab parametrizes the interpolation accuracy for precession drilling.

Changing interpolation accuracy is not recommended.

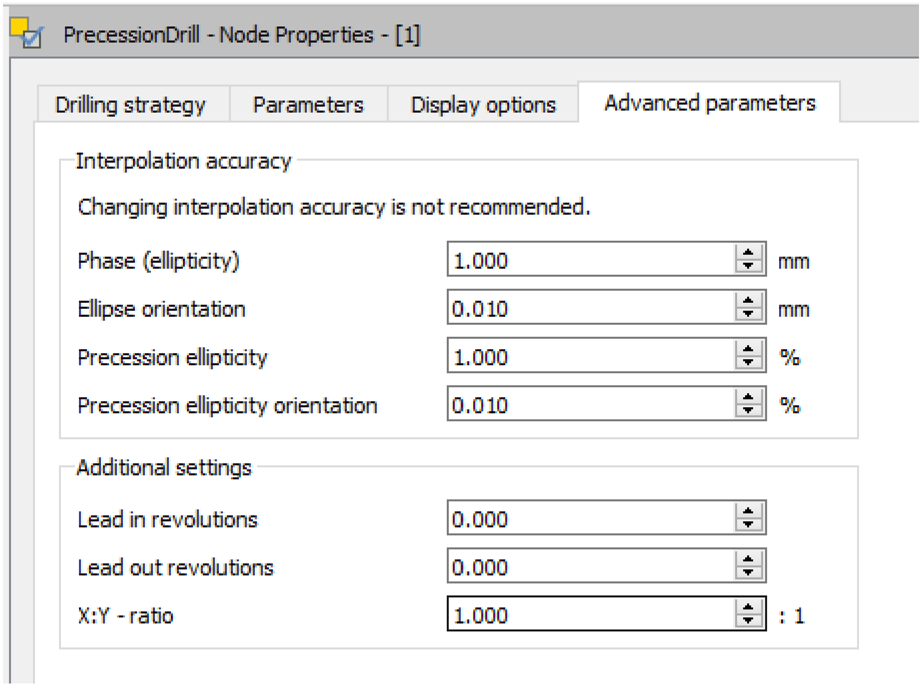


Figure 5.15: Precession Drill job node - Advanced parameters tab

Description of figure 5.15 on page 88:

Interpolation accuracy sets the interpolation accuracy.

Phase (ellipticity) sets the interpolation accuracy for the phase (ellipticity).

Ellipse orientation sets the interpolation accuracy for the ellipse orientation.

Precession ellipticity sets the interpolation accuracy for the precession ellipticity.

Precession ellipticity orientation sets the interpolation accuracy for the precession ellipticity orientation.

Additional settings sets additional drilling settings.

Lead in number of revolutions for the axes to lead in before drilling starts.

Lead out number of revolutions for the axes to lead out after drilling has ended.

X:Y - ratio sets the ratio between the two perpendicular axes X and Y. This value can be used to rotate rectangular holes.

5.14 Cutting Edge

The Precession Elephant 2/3 allows the user to control both the position of the laser spot on a work piece as well as the beam incidence angle. For drilling processes, the beam incidence angle is also called the precession angle. Find an illustration of terms in figure 5.16 on page 90.

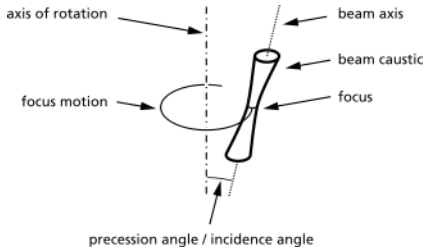


Figure 5.16: Terms

The purpose of the Cutting Edge node is to allow the user to control the ablation process and the vertical angle of the edges of arbitrarily shaped cuts through a workpiece.

Hole geometries with a circular, elliptic or rectangular cross section can be achieved by using the Precession Drill job node (formerly called Spiro3D), which can be more efficient for these particular geometries.

Under the control of a Cutting Edge job node the Precession Elephant scan head generates the desired motion of the beam focus and of the precession angle from the wobble and precession parameters of that Cutting Edge node and from the arbitrary 2D path trajectory defined by its subnodes.

For optimal ablation the focal plane is lowered into the workpiece in incremental steps configured by the Starting depth, Step depth and Number of steps parameters, and at each focal plane position the ablation process can be repeated multiple times if necessary controlled by the Path repetitions at every depth step parameter.

To avoid having the removal of material from the workpiece impeded by partial obstruction of the laser beam caused by excess leftover material above the current beam waist position, a time dependent circular position offset ('wobble') can be added to the path trajectory. The vertical angle of the re-

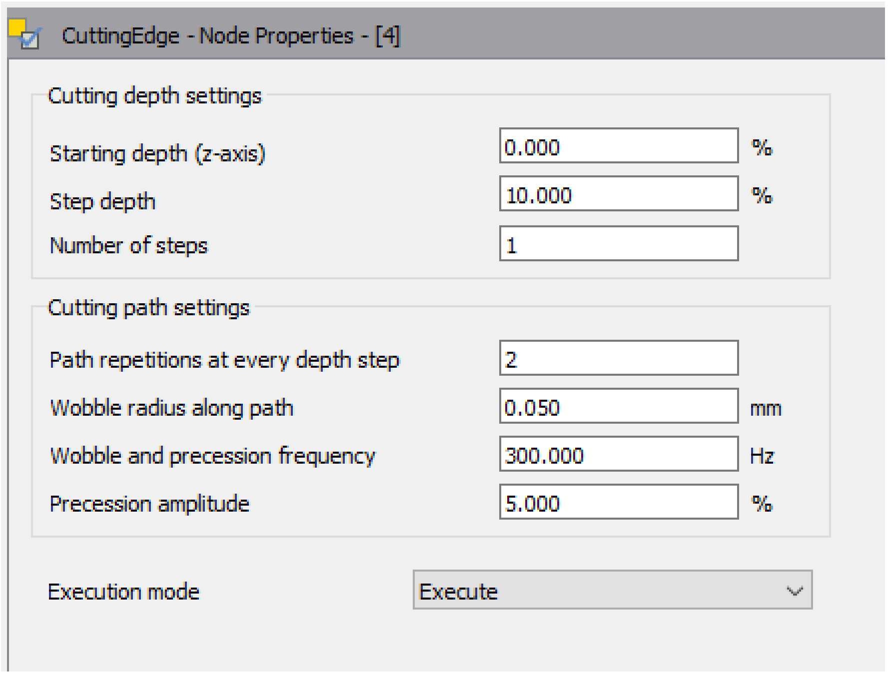


Figure 5.17: Cutting Edge parameters

sulting edges is affected by the parameter ”Precession Amplitude”.

Zero taper means that the shape and size on the entry and exit sides of the workpiece are the same. Positive taper means that the hole size on the entry side is bigger than on the exit side, and vice versa for negative taper. If the ”Wobble radius is positive, a larger ”Precession Amplitude” value means a more negative taper. If the ”Wobble radius is negative, a smaller ”Precession Amplitude” value means a more negative taper.

5.14.1 Parameters

Cutting depth settings parameters that control the focal plane Z actuator value during the process

Starting depth (z-axis) the Z actuator value at the start of the process

Step depth the amount by which the Z actuator value is incremented from one focal plane position to the next

Number of steps the total number of focal plane positions to run the process at

Cutting path settings parameters that control the execution of the subnodes for each focal plane position

Path repetitions at every depth step the number of times the cutting path will be executed at each position of the focal plane

Wobble radius along path the radius at which the beam waist will be moved in a circular motion around the cutting path position

Wobble and precession frequency the frequency at which the system will apply the wobble and precession motion to the cutting path

Precession amplitude controls the precession angle. Please note that the relationship between this parameter and the precession angle is nonlinear and depends on a number of process parameters, which means that experiments will be necessary to find the perfect value for each application

5.14.2 Requirements

A Precession Elephant scan head must have been selected in the dist_xy device driver during the scan field calibration procedure.

The Linehandling mode in the linepar device must be set to Actuator LH.

5.15 External select

Using the External Select node and parallel electrical inputs of the ASC, a subtree beneath the External Select node can be selected for execution by evaluating digital inputs. Up to 8 digital inputs can be used for this purpose.

5.15.1 Configuration of External Select job node

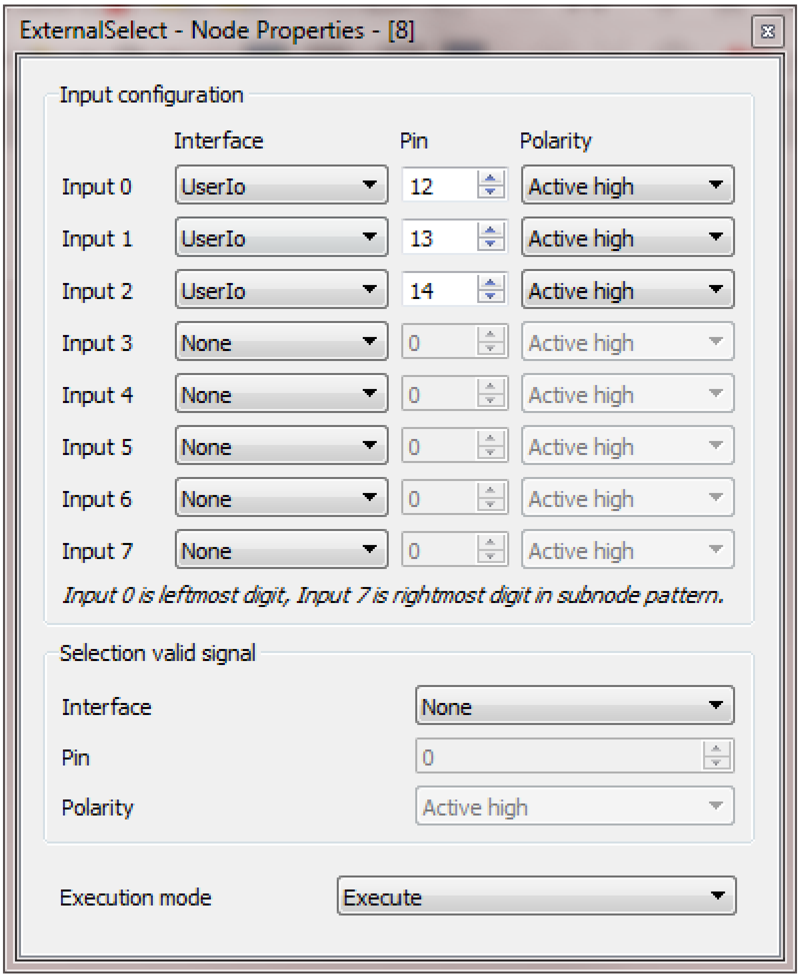


Figure 5.18: External Select job node

Input 0..7 Interface Select the hardware interface of which you want to assign an input pin for the External Select. Depending on the interface used, you may have to configure an additional driver for the interface (e.g. for UserIo). Select None if you do not want any further digits to be evaluated. Please note that the inputs must be assigned continously, i.e it is not allowed to have intermediate None entries where others follow.

Input 0..7 Pin Depending on the selection of the Interface you can assign the pin number. Note that the different interfaces have different count of pins available so you can not select every value for every Interface selection. If you configured Interface to None then this field is unavailable.

Input 0..7 Polarity Select the polarity for this digital input. If you configured Interface to None then this field is unavailable.

Selection valid signal In this section you can configure the Interface, Pin and Polarity for a Selection Valid signal if you want or need to use this. Leave the Interface to None if you do not want to use a Selection Valid signal.

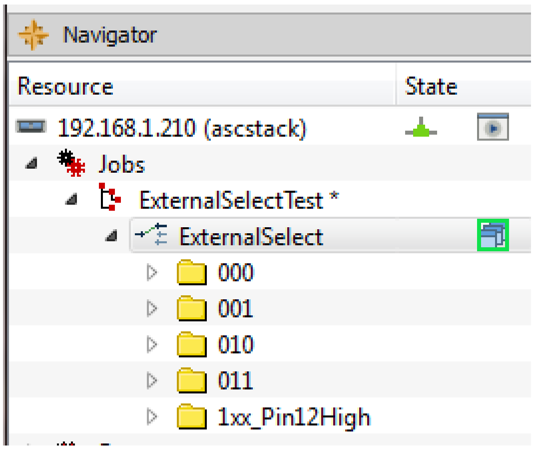


Figure 5.19: External Select Job example

5.15.2 Using the External Select job node

Procedure

1. Add a Group node beneath the External Select node for each subtree

2. Rename the Group nodes to reflect the bit pattern of the digital inputs
3. Add your subjob content to each Group node.

The bit pattern within the first n characters of the node Group node name is analyzed for the selection. n is the number of configured inputs in the External Select node. The first character within this bit pattern is the least significant bit. This bit corresponds to Input 0. The n-th character is the most significant bit and corresponds to the last configured input.

The following characters are allowed for the bit pattern:

0 The pattern matches if the input for this character is inactive.

1 The pattern matches if the input for this character is active.

x or X The input for this character is ignored, i.e. the pattern matches no matter if its input is active or inactive.

Following the n characters of the pattern there can be any other allowed character to give the Group a more meaningful name.

Note that if more than one pattern matches (either because you used the same exact bit pattern more than once or because you used x to ignore some inputs) all the matching subtrees are executed one after the other.

Since the inputs can be configured as Active low in the Polarity section of the External Select the characters in the bit pattern always represent the logical value, not the electrical one. I.e. an active low input of 0V will match to a 1 in the corresponding bit pattern.

5.15.3 Timing Diagram

Depending on your usecase you can use the External Select in two different scenarios.

1. Select a subtree with the digital inputs and then start the job. Every job cycle will execute one subtree depending on the current state of the digital inputs. Changes in the digital inputs must be done after the job finished and before the next job is started.
2. Start a job containing a Loop node and an External Select node. With the Loop node the job executes the External Select multiple times and

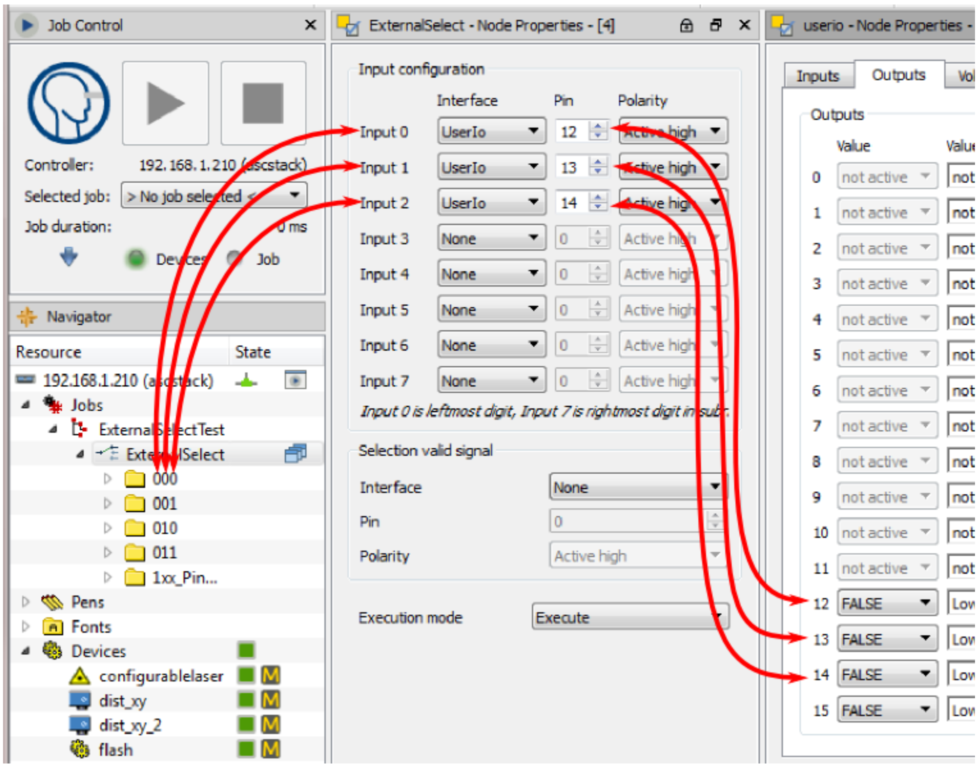


Figure 5.20: External Select usage

for every loop the selection of the digital inputs can be changed.

TIP

It is strongly recommended to use the first, simpler case and start the job for every selection again.

Timing Diagram single execution

1. Set the selection on the configured digital inputs when the controller states Job Ready.
2. As soon as the selection on the configured digital inputs is stable, you can set the Job Start to start the selected job. Do not change the digital inputs as long as the job is running.

Timing Diagram loop execution

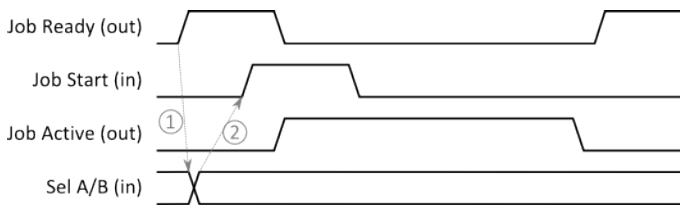


Figure 5.21: External Select timing for single execution

In case you execute a job with a Loop node where the External Select is executed multiple times with different digital input signals in one job cycle, you have to use an additional handshake signal to tell your subordinate machine control that the current selection has been accepted and the one for the next cycle can be set. Additionally, you have to use the selection valid signal to tell the External Select job node that the settings on the digital inputs are stable and valid for this job cycle.

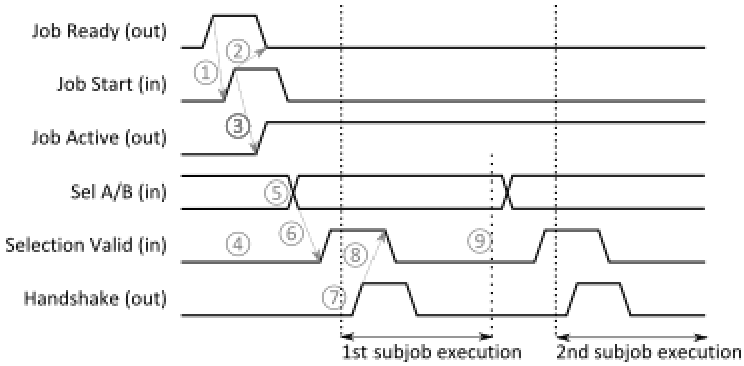


Figure 5.22: External Select timing for looped execution

(1) When the controller shows its readiness by an active Job Ready signal you may request the execution of a job by setting the Job Start signal to active.

(2) The controller acknowledges the Job Start signal by setting the Job Ready signal to inactive.

(3) The controller shows the beginning of job execution by setting the Job Active signal.

(4) The Selection Valid signal must be inactive to prevent executing an arbitrary subtree.

(5) When the job is running and while the Selection Valid signal is inactive you may change the selection at the digital inputs Input 0 to Input 7 (whatever is configured in the External Selection job node).

(6) As soon as valid data is set to the digital inputs, accept this data by setting the Selection Valid signal to active.

(7) The External Select job node waits for the Selection Valid signal and starts executing one of its subnodes after this signal gets active. You should implement some kind of handshake to signal your PLC that the subtree is being executed and you may put the Selection Valid signal to inactive. There is currently no configurable handshake mechanism so you will need to write a script to implement this. See example below. If you know the run length of your job you might be able to pass the handshake and reset the Selection Valid after some time. In that case you must find a proper time that is long enough that the controller can detect the Selection Valid signal for sure but it will be reset before the next job loop starts.

(8) After your PLC sees the handshake signal it must reset the Selection Valid in order to prevent the next job cycle to execute the last selection again.

(9) There is no signal that shows that the subtree was executed and the Selection Valid node waits for its next selection. If you don't know the timing of your jobs you will probably have to implement a second handshake signal to notify your PLC that it can not set the next selection and start over again.

Additional handshake signal

You can add additional digital handshake signals to control your program flow by adding Script nodes to the subtrees that are executed from the External Select and modify a digital output from that script.

Assuming you have a UserIo device with configured output 0 activated you can use the following script to set this output to high:

```
$dev.userio.out.0.value$ = ”TRUE”;
```

Don't forget to set the output to FALSE again before the next loop.

TIP

You have to put the TRUE in quotation marks and write it in upper case letters because the variable value is a selection variable that can either contain the string TRUE or FALSE.

6 Job nodes: Input / Output

Comment

6.1 Comment

Using Comment job node you may add remarks and comments into the tree structure of the job. It is completely neutral and executes no further function.

7 Devices: Important note

If a job contains a pen section for a device and you deactivate that device, then that pen section will have no control over the device even if you activate the device later. You will not get a warning about this. In this case, perform the following procedure.

Procedure

1. Save the job.
2. Activate the device.
3. Reload the job.

8 Devices: ”Device states” tab

The following describes the Device states tab that is common to most devices.

8.1 Requirements

- The respective device has to be active.

8.2 Viewing the device states

Procedure

1. Edit the respective device’s settings, see [1] chapter Managing Devices.
2. On the Device states tab, view the current Message port trigger ∼, Parameter ∼, Error ∼, Power ∼ and (Power) Target state state.

8.3 Resetting the error state

Procedure

1. Edit the respective device’s settings, see [1] chapter Managing Devices.
2. On the Device states tab in the Error group, click **Reset**.

   This action will only be successful if the error is not present any more.

8.4 Configuring the power behav.

Procedure

1. Edit the respective device’s settings, see [1] chapter Managing Devices.
2. On the Device states tab in the Power group, select the Lowest state that is allowed to be reached during normal operation.

   The following states are possible in the given order: ready > standby > down > off
3. In Ready to standby timeout, Standby to down timeout and Down to off timeout, set the time between these states.

   Remaining timeout shows the time that remains until the next lower state will be initiated.

8.5 Temporarily forcing the ”ready” power state

Procedure

1. Edit the respective device’s settings, see [1] chapter Managing Devices.
2. On the Device states tab, activate **Attention**.

   As long as Attention is active, the device is forced to remain in the ready power state. This does not change the setting in Lowest state.

9 Devices: Laser

Synchronization of gate signals

ConfigurableLaser

SpiGen3

Dart

IpgYlp

9.1 Synchronization of gate signals

The following describes briefly the 3 most common options to synchronize a laser with the job output driven by the ASC system controller.

9.1.1 Option 1

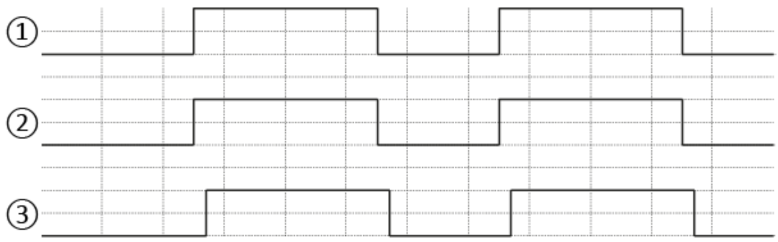


Figure 9.1: (Delayed (3)) output gate signal (2) synchronized to internal gate (1)

(1) internal gate signal:

In the firmware we refer to the laser switch-on and switch-off points in time as internal gate signal. These points in time are due to the elements in a job and the line parameters (heads, tails, etc.; see also section Linepar). The internal gate signal can be seen as the ”mother” of all gate signals.

(2) output gate signal on HSO (High Speed Output) pin; synchronized to internal gate signal:

The most common option is a gate signal that is output via a HSO pin and synchronized to the internal gate signal. As result the output gate signal and the internal gate signal ”open” and ”close” at the same time.

(3) output gate signal on HSO (High Speed Output) pin; synchronized to internal gate and delayed:

In some cases it is necessary to ”open” and ”close” the output gate signal delayed to the internal gate signal. Parameters are like before but the the output gate signal gets a delay relating to the internal gate signal.

9.1.2 Option 2

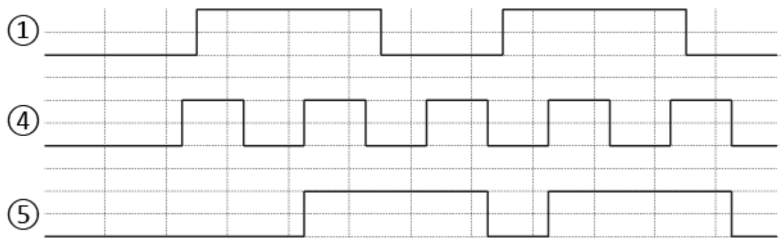


Figure 9.2: Output gate signal (5) synchronized to oscillator or High Speed Input (4)

(1) internal gate signal as in Option 1

(4) external sync signal on HSI (High Speed Input) pin –OR– free running oscillator (OSC):

The second common option is to synchronize an external sync signal to an oscillator signal no matter which type. An OSC signal by the A-RGES system controller equates a free-running oscillator with defined frequency but undefined phasing.

(5) gate signal on HSO (High Speed Output) pin; synchronized to OSC:

The gate signal, output on a HSO pin, responds to the internal gate signal but waits with its raising edge until the sync signal –the free-running oscillator– also has a raising edge. ”Closing” the output gate works the similar way. When the logic low level of the internal gate signal meets the falling edge of the sync signal then the output gate signal level becomes low.

9.1.3 Option 3

The third option is to synchronize the external gate signal to an external signal. Here all signals accord to the signals shown in the figure of the 2^{nd}. option. The only difference is that the oscillator signal is not generated by the ARGES system controller but is generated by an external source and input through a HSI (High Speed Input) pin.

9.2 ConfigurableLaser

The ConfigurableLaser device is able to drive various laser types. Use this device only if no specific device is available for your laser.

9.2.1 Requirements

- The laser is connected to the LASER connector at the ARGES system controller. This is done via a so called Generic Laser Cable (GLC). The documentation can be found in the ASC manual.
- Knowledge about how the laser is connected to the ARGES system controller.

9.2.2 Configuration

Configure the parameters necessary for your laser and consider details from the laser's user manual.

9.2.2.1 Configuring the gate signal

Requirement

- To control the gate, this laser function has to be connected to one of the high speed I/Os (HSIO0 through HSIO7) at the LASER connector of the ASC system controller.

Procedure

1. If no gate signal shall be used then select **None** on the Gate tab in Config. In this case further settings on this tab do not take effect.

   – OR –

   If a gate signal shall be used then select **Gate** on the Gate tab in Config.
2. Select the Signal that is used for the gate signal. The upper mentioned high speed I/Os can be used as outputs and thus they are named **HSO0** to **HSO7** here.

3. Select the Polarity of the signal:

   If a low signal level means that the gate shall be active then select **Active Low**.

   – OR –

   If a high signal level means that the gate shall be active then select **Active High**.

4. Set the gate signal Delay.
5. As Sync-signal, select the signal to which the Gate signal synchronizes. This can be one of **InternalGate**, **Osc** or one of the inputs **HSIO0** up to **HSIO7**; see also section Synchronization of gate signals.
6. The Gate capture field defines which HSIO pin is used for the capturing of the gate signal which is transmitted in the tracked laser switching times TSS. If only one laser device is used then this field should be set to Auto. If more than one laser device is used, then this field may only be set to Auto for one laser device, it has to be set to Disabled for all other laser devices.

9.2.2.2 Configuring the oscillator signal

Procedure for internal continuous signal

Requirement

- To control the laser internal oscillator this laser function has to be connected to one of the high speed I/Os (HSIO0 through HSIO7) at the LASER connector of the ASC system controller.

Procedure

1. If no internal continuous oscillator signal shall be used then select **None** on the Osc tab in the Internal continuous group in Config. In this case further settings in this group do not take effect.

   – OR –

   If an internal continuous oscillator signal shall be used then select **Continuous** on the Osc tab in the Internal continuous group in Config.

2. Select the Signal that is used for the oscillator signal. The upper mentioned high speed I/Os can be used as outputs and thus they are named **HSO0** to **HSO7** here.
3. Select the Polarity of the signal:

   If a low signal level means that the gate shall be active then select **Active Low**.

   – OR –

   If a high signal level means that the gate shall be active then select **Active High**.
4. Set the oscillator signal Delay.
5. Set Substitution to **Osc** if oscillation must not be completely interrupted (e.g. for quicker response on fiber laser and bitmap modulation) else set it to **None**.
6. Set further parameters in the Internal common group; see section Further procedure for internal signal.

Procedure for internal gated signal

Requirement

- To control the laser internal oscillator this laser function has to be connected to one of the high speed I/Os (HSIO0 to HSIO7) at the LASER connector of the ASC system controller.

Procedure

1. If no internal gated signal shall be used then select **None** on the Osc tab in the Internal gated group in Config. In this case further settings in this group do not take effect.

   – OR –

   If an internal gated signal shall be used then select **GatedOsc** on the Osc tab in the Internal gated group in Config.
2. Select the Signal that is used for the gate signal. The upper mentioned high speed I/Os can be used as outputs and thus they are named **HSO0**

to **HSO7** here.

3. Select the Polarity of the Signal:

   If a low signal level means that the gate shall be active then select **Active Low**.

   – OR –

   If a high signal level means that the gate shall be active then select **Active High**.

4. Set the oscillator signal Delay.
5. In Sync-signal, select the signal to which Osc synchronizes. This can be one of **InternalGate**, **Osc** or one of the inputs **HSIO0** up to **HSIO7**; see also section Synchronization of gate signals. Please note that if you configure an overlapping Gate/GatedOsc signal, then the signal will always be synchronized to the **InternalGate**.
6. If you configure an overlapping Gate/GatedOsc signal, then the firmware needs to use two additional auxiliary high speed I/Os for internal purposes. The fields Aux Signal 1 and Aux Signal 2 allow to choose which high speed I/Os the firmware shall use. If no overlapping Gate/GatedOsc signal is configured then the settings in those fields have no effect.
7. Set further parameters in the Internal common group; see section Further procedure for internal signal.

Further procedure for internal signal

Requirement

- Either an internal continuous (see section Procedure for internal continuous signal) or an internal gated (see section Procedure for internal gated signal) oscillator signal is used.

Procedure

1. Set the Min duty cycle and Max duty cycle of the oscillator signal.

   The duty cycle is the fraction of time that a system is in an active state. It is the duration that the function is active high (normally when the signal is greater than zero) divided by the period of the function.

2. Set the lower and upper limit, Min time on and Max time on, for the time that the oscillator signal shall be on.
3. Set the lower and upper limit, Min time off and Max time off, for the time that the oscillator signal shall be off.

Procedure for external signal

Requirement

- An external signal shall be used.

Procedure

1. If no external oscillator signal shall be used then select **None** on the Osc tab in the External group in DAC. In this case further settings in this group do not take effect.

   – OR –

   If an external oscillator signal shall be used then select DAC to **DAC A**, **DAC B**, **DAC C** or **DAC D**, where the external oscillator signal is connected at the ARGES system controller; see also section Synchronization of gate signals.
2. In Scale, set the relation of voltage to frequency.

Limiting the frequency range

- On the Osc tab in the Frequency group, set the lower and upper limit for the oscillator frequency in Minimum frequency and Maximum frequency.

9.2.2.3 Configuring first pulse suppression for a Q-switched laser

Q-switched lasers often have a first pulse in a string of pulses that contains a much higher energy level than those that follow. Thus First Pulse Suppression (FPS) can be configured to suppress the first pulse.

Requirement

- To control the first pulse suppression this laser function has to be connected to one of the high speed I/Os (HSIO0 through HSIO7) at the LASER connector of the ASC system controller.

Procedure

1. If no first pulse suppression shall be performed then select **None** on the FPS tab in the Parameters group in Config. In this case further settings on this tab do not take effect.

   – OR –

   If a first pulse suppression shall be performed then select **Delayed gate** on the FPS tab in the Parameters group in Config.
2. Select the Signal that is used as first pulse suppression signal. The upper mentioned high speed I/Os can be used as outputs and thus they are named **HSO0** to **HSO7** here.
3. Select the Polarity of the signal:

   If a low signal level means that the first pulse suppression shall be performed then select **Active Low**.

   – OR –

   If a high signal means that the first pulse suppression shall be performed then select **Active High**.
4. Set the first pulse suppression signal Delay.

9.2.2.4 Configuring the grayscale pixel modulation

Requirement

- To control the modulation of the optical output power this control signal has to be connected to the ARGES system controller. If the signal is digital then one of the Digital Analog Converter (DAC) signals at the LASER connector has to be connected to the optical output power modulation signal. If the signal is analog then one of the high speed I/Os (HSIO0 to HSIO7) signals at the LASER connector has to be connected to the optical output power modulation signal.

Procedure for digital signal

1. On the Modulation tab in the Analog group, set DAC to **None**. In this case further settings in the Analog group do not take effect.
2. In the Digital group, set Config to **Digital**.
3. Select the Signal that is used for the modulation signal. The upper mentioned high speed I/Os can be used as outputs and thus they are named **HSO0** to **HSO7** here.
4. Select the Polarity of the signal:

   If a low signal level means that the modulation signal shall be active then select **Active Low**.

   – OR –

   If a high signal level means that the modulation signal shall be active then select **Active High**.
5. Set the modulation signal Delay.
6. In Sync-signal, select the signal to which the modulation signal synchronizes. This can be one of **InternalGate**, **Osc** or one of the inputs **HSIO0** up to **HSIO7**.
7. Set the Min. duty cycle and Max. duty cycle of the modulation signal.

   The duty cycle is the fraction of time that a system is in an active state. It is the duration that the function is active high (normally when the signal is greater than zero) divided by the period of the function.
8. Set the lower and upper limit, Min. time on and Max. time on, for the time that the modulation signal shall be on.
9. Set the lower and upper limit, Min. time off and Max. time off, for the time that the modulation signal shall be off.

Procedure for analog signal

1. On the Modulation tab in the Digital group, set Config to **None**. In this case further settings in the Digital group do not take effect.
2. In the Analog group, set DAC to **DAC A**, **DAC B**, **DAC C** or **DAC D**, where the modulation signal is connected at the ARGES system controller.

3. In Min. power at and Max. power at, set the output voltage that shall be used for minimal and maximal optical output power.

   If the processed material gets darker when more optical power is applied then Min. power at would be equivalent to “white” and Max. power at would be equivalent to “black”.

   If the processed material gets lighter when more optical power is applied then Min. power at would be equivalent to “black” and Max. power at would be equivalent to “white”.

4. Set the modulation signal Delay.

9.2.2.5 Configuring the power setting signal

Requirement

- To control the optical output power this laser function has to be connected to one of the Digital Analog Converter (DAC) signals at the LASER connector of the ARGES system controller.

Procedure

1. On the Power tab, set the DAC to which the laser power signal is connected to at the ARGES system controller:

   If there is no laser power signal connected then select **None**. In this case further settings on this tab do not take effect.

   – OR –

   If the laser power signal is connected to one of the DACs then select the corresponding **DAC A**, **DAC B**, **DAC C** or **DAC D**.

2. In Min. power at and Max. power at, set the output voltage that shall be used for minimal and maximal optical output power.

   InScript maps the voltage to a percentage; see also figure 9.3 on page 115 .

3. In Power range low and Power range high, you can restrict the percentage to a range that is mapped to a range from 0 to 100 % again; see also figure 9.3 on page 115 . The latter percentage is used when setting

the power in the device or pen.

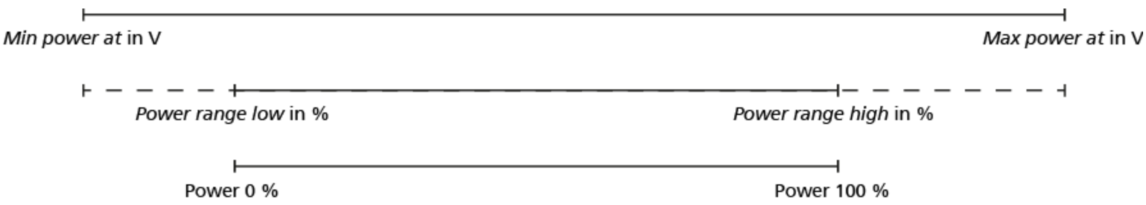


Figure 9.3: Voltage to percentage mapping for power

9.2.2.6 Configuring the pointing laser control signal

Requirement

- To control a pointing laser present in your laser the pointing laser has to be connected either to the GENERAL PURPOSE I/O or to the the LASER connector of the ARGES system controller.

Procedure

1. In the PointingLaser tab, set the Port to which the pointing laser is connected at the ARGES system controller:

   If there is no pointing laser present then select **None**. In this case further settings on this tab do not take effect.

   – OR –

   If the pointing laser is connected to the GENERAL PURPOSE I/O connector then select **UserIO**.

   – OR –

   If the pointing laser is connected to the LASER connector then select **HSIO**.

   – OR –

   The setting **GLA** is currently not implemented and reserved for future use.

2. Select the Signal number that is used for the pointing laser control signal at the port that you have selected.

3. Select the Polarity of the signal:

   If the pointing laser needs a low signal level to be switched on then select **Low -**> **On**.

   – OR –

   If the pointing laser needs a high signal level to be switched on then select **High -**> **On**.

9.2.2.7 Configuring the interlock signals

Requirement

- To monitor interlocks present in your laser these interlocks have to be connected either directly to the GENERAL PURPOSE I/O connector or to the LASER connector of the ARGES system controller.

Procedure

Up to 8 interlocks (A to H) can be monitored. They all can be configured in the same way:

1. On the Interlocks tab on one of the tabs A through H, set the Port to which the interlock is connected at the ARGES system controller:

   If there is no interlock present then select **None**. In this case further settings on this tab do not take effect.

   – OR –

   If the interlock is connected to the GENERAL PURPOSE I/O connector then select **UserIO**.

   – OR –

   If the interlock is connected to the LASER connector then select **HSIO**.

   The settings **GLA** and **Virtual** are currently not implemented and reserved for future use.

2. Select the Signal number that is used for the interlock at the port that you have selected.

3. Select the Polarity of the signal:

If a low signal means that the interlock reports a fault then select **Fault -> Low**.

– OR –

If a high signal means that the interlock is reports a fault then select **Fault -> High**.

4. In Name enter a name for the interlock.

   This name is used for the respective interlock in the Messages view.

9.2.2.8 Configuring the shutter signal

Requirement

- To control a safety and/or process shutter present in your laser the shutter has to be connected either directly to the GENERAL PURPOSE I/O connector or to the LASER connector of the ARGES system controller.

Procedure

The Safety shutter as well as the Process shutter can be configured in the same way:

1. On the Shutter tab either in the Safety shutter or the Process shutter group, set the Port to which the shutter is connected at the ARGES system controller:

   If there is no shutter present then select **None**. In this case further settings on this tab do not take effect.

   – OR –

   If the shutter is connected to the GENERAL PURPOSE I/O connector then select **UserIO**.

   – OR –

   If the shutter is connected to the LASER connector then select **HSIO**.

   – OR –

   The setting **GLA** is currently not implemented and reserved for future use.

2. Select the Signal number that is used for the shutter at the port that you have selected.
3. Select the Polarity of the signal:

   If the shutter needs a low signal level to be open then select **Low ->** **Open**.

   – OR –

   If the shutter needs a high signal level to be open then select **High ->** **Open**.

9.2.2.9 Completing the configuration

Procedure

1. Activate the ConfigurableLaser device, see [1] chapter Managing Devices.
2. Make the device configuration permanent, see [1] chapter Managing Devices.

9.2.3 Usage

In the following procedures consider details from the laser's user manual.

9.2.3.1 Setting the optical output power

Requirements

- In the inactive device on the Power tab, a DAC has been configured for this purpose.

Procedure

1. Use the InScript software's pen mechanism to change optical output power during a job; see [1] chapter Working with Pens
2. Edit the configurablelaser pen-section settings, see [1] chapter Working with Pens.

3. On the Control tab, set the Power.

TIP

Measure the optical output power at different percentage and plot a curve with optical output power over percentage.

9.2.3.2 Switching the pointing laser

Requirements

- In the inactive device on the PointingLaser tab, a Port has been configured for this purpose.

Procedure

1. Edit the configurablelaser device settings, see [1] chapter Managing Devices.
2. On the Control tab in Pointing laser, select **On** or **Off**.

9.2.3.3 Switching on and off the laser emission (and other oscillator signal related parameters)

The configurablelaser device drives a class 4 laser product according to DIN EN 60825-1:2008-05.

Consider specifications from the laser's user manual.

Requirements

- In the inactive device on the Gate tab, Config has been set to Gate for this purpose and on the Modulation tab, a modulation signal has been configured where applicable for grayscale pixel modulation.

Procedure

1. Use the InScript software's pen mechanism to change oscillator related parameters during a job; see [1] chapter Working with Pens
2. Edit the configurablelaser pen-section settings, see [1] chapter Working with Pens.

3.

⚠ CAUTION

Visible and/or invisible laser radiation

Damage to eye or skin

a) Avoid eye or skin exposure to direct or scattered radiation.

b) On the Control tab, select the Gate control.

Always off switches off the oscillator, i.e. the laser emission, even if a job is being executed.

Always on switches on the oscillator, i.e. the laser emission, even if a job is being executed.

Auto switches the oscillator, i.e. the laser emission, automatically on and off according to the job that is being executed. Between jobs the oscillator, i.e. the laser emission, is off.

4. On the Osc tab, select the oscillator signal Frequency, On time and Gate delay.

5. Gate delay: Laser gate ”on” delay [µs], affects the rising edge of the laser ”gate” signal.

6. Gate delay off delta: Difference between the laser gate ”off” delay and the laser gate ”on” delay [µs], affects the falling edge of the laser ”gate” signal.

   If the value of Gate delay off delta is 0 the laser gate ”off” delay is the same as the laser gate ”on” delay.

   If the value of GateDelayOffDelta is greater than 0 the laser gate ”off” delay is longer than the laser gate ”on” delay.

   If the value of GateDelayOffDelta is less than 0 the laser gate ”off” delay is shorter than the laser gate ”on” delay.

   The effective laser gate ”off” delay is the sum of the values of ”Gate delay” and ”Gate delay off delta”.

7. If grayscale pixel modulation is relevant then, on the Osc tab, switch the Modulation control similar to Gate control and set the modulation signal

Modulation on time and Modulation delay.

9.2.3.4 Switching the safety and process shutter manually

Procedure

1. Edit the configurablelaser device settings, see [1] chapter Managing Devices.
2. On the Control tab, set Safety shutter or Process shutter to either **Closed** or **Open**.

9.2.3.5 Viewing oscillator signal related parameters

Procedure

1. Edit the configurablelaser device settings, see [1] chapter Managing Devices.
2. On the Osc tab, view parameters which have been configured in the inactive device on tabs Osc and Modulation.

9.2.3.6 Setting conditions for and reading the states of interlocks

Procedure

1. Edit the configurablelaser device settings, see [1] chapter Managing Devices.
2. On the Interlocks tab, set the Start condition and Fail condition for the Safety shutter, Process shutter and Interlock A through H.
3. On the Interlocks tab, view the Status of Interlock A through H.

9.3 SpiGen3

Use the SpiGen3 device to drive a SPI G3 or SPI G4 laser connected to the ASC. Possible connection interfaces are RS232, GLA (Generic Laser Adapter), SPA (SPI Laser Adapter) and DI-SPA (Direct Interface-SPI Laser Adapter). Different settings can be made to control the pulse rate, power, selection of CW or pulsed mode and the pilot laser of the SPI laser device.

The SPI G4 laser supports 8 different modes in which the laser can be operated. Depending on the interface, the ASC (ARGES system controller) firmware selects the laser mode. For the RS232 interface, the laser is always operated in mode 0. For the GLA and SPA interfaces, the laser is always operated in mode 5. For the DI-SPA interface, the laser can be operated in mode 5 or 6, depending on user configuration of the mode. Please consult the laser manual for more information about the laser modes.

9.3.1 Requirements

- The SPI laser is properly connected to the ASC via one of the above mentioned interfaces, RS232, GLA, SPA or DI-SPA. Please contact ARGE-S if you do not know which interface is supplied with your ASC to which the SPI laser shall be connected.
- If the SPI laser is supplied with power from an external power supply then it has to be powered on before the device can be used.

9.3.2 Configuration

TIP

If you purchased a subsystem consisting of a laser and an ARGE-S system controller from ARGES then the respective device driver should already be present and configured due to testing procedures done at ARGES. In this case just check the settings that are done in the following procedure.

In the following procedure consider details from the laser's user manual.

Procedure

1. Create a new SpiGen3 device and edit its configuration, see [1] chapter Managing Devices.
2. If the laser power supply is hosted within the ARGES system controller then select the SPD resource which the device driver shall use to power the laser:
   a) If none is displayed then click **Detect**.

      If a SPD resource is detected then it will be listed. If no device is detected then there will be no feedback on this result.
   b) In SPD port, select both Laser even if there is only 1 laser to supply.
3. Select the Interface, DI-SPA laser mode and set the Pulse trigger delay:

   Selecting the SPI laser interface Depending on the way the SPI laser is connected to the ASC, the correct Interface has to be selected. This can either be RS232, GLA, SPA_Laser_1, SPA_Laser_2 or DI_SPA. For ASC Gen 4 systems, DI_SPA is usually the right choice. Please contact ARGES if you do not know which interface is supplied with your ASC to which the SPI laser shall be connected.

   Selecting the DI-SPA laser mode If the SPI laser is connected to the ASC via a DI-SPA interface then the mode the SPI laser is operated in can be selected. Simply change the setting DI-SPA Laser Mode to either 5 or 6. Please consult the laser manual to get more information about the differences between those 2 laser modes. If the SPI laser is connected to the ASC via another interface (not DI-SPA) then this setting does not have any effect.
4. Activate the SpiGen3 device, see [1] chapter Managing Devices.
5. On the SPI tab check the information about the SPI G3/G4 laser.
6. On the Device states tab, set the Lowest state you want to allow, where the power state machine states ready, standby, down and off are mapped as follows:

   ready The laser is ready for emission.

   standby The laser's emission is suspended.

down The laser is disabled.

off The laser may be switched off.

7. On the Device states tab, set the Ready to standby timeout, Standby to down timeout and Down to off timeout for state transitions to requirements.
8. Make the device configuration permanent, see [1] chapter Managing Devices.

9.3.3 Usage

For the following procedures consider details from the laser's user manual.

9.3.3.1 Setting the optical laser power

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the Control tab, set Power to a percentage of maximum power.

TIP

Measure the optical laser power at different percentages and plot a curve with power over percentage.

9.3.3.2 Switching on and off the laser emission

The SpiGen3 device is a class 4 laser product classified according to IEC EN 60825-1:2015-07. Consider specifications from the laser's user manual.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2.

⚠ CAUTION

Visible or invisible laser radiation

Damage to eye or skin

a) Avoid eye or skin exposure to direct or scattered radiation.

b) On the OSC tab, select for Gate control one of the following:

Always off switches off the oscillator, i.e. the laser emission, even if a job is being executed.

Always on switches on the oscillator, i.e. the laser emission, even if no job is being executed.

Auto switches the oscillator, i.e. the laser emission, automatically on and off according to the job that is being executed. Between jobs the oscillator, i.e. the laser emission, is off.

9.3.3.3 Setting the pulse repetition rate

The pulse repetition rate (pulse frequency) controls how many pulses the laser emits per second when operated in pulsed mode.

Requirements

- The laser has to be operated in pulsed mode.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the OSC tab, set Frequency to the required value.

9.3.3.4 Setting the gate delay

Laser emission is controlled by an electrical gate-signal, which can be delayed in steps of microseconds via gateDelay in relation to the internal on-signal.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the OSC tab, set Gate delay to the required value.

9.3.3.5 Setting the FPE signal

Requirements

- The FPE (First Pulse Equalization) signal can only be used with the DI-SPA interface and only when Laser mode 6 was selected in the configuration.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the FPE tab, select for Control one of the following:

   Always off switches off the FPE signal, even if a job is being executed.

   Always on switches on the FPE signal, even if no job is being executed.

   Auto switches the FPE signal, automatically on and off according to the job that is being executed. Between jobs the FPE signal is off.
3. On the FPE tab, set Delay and Duration according to requirements. The Delay value is the delay time between a rising edge of the gate signal and a rising edge of the FPE signal. The Duration value is the time the FPE signal stays active.

9.3.3.6 Setting the waveform

A typical SPI laser model supports multiple waveforms. Please consult the laser manual to see which specific waveforms are supported by this model.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the SPI tab, set Waveform to the required waveform.

9.3.3.7 Switching between pulsed and CW mode

Not all SPI laser models support CW mode. Please consult the laser manual to see if CW mode is supported.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the SPI tab, set Pulsed CW mode to Pulsed or CW.

9.3.3.8 Setting the simmer current

Requirements

- This setting is only applicable with RS232 and DI-SPA interfaces.
- In addition, this setting has no effect if the DI-SPA interface is used together with laser mode 6. Please consult the laser manual on laser modes.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the SPI tab, set Simmer Current to the required value from 0 % to 100 %.

9.3.3.9 Setting the burst length

Requirements

- This setting is only applicable if the RS232 interface is used (Laser is operated in laser mode 0 (software mode)). Please consult the laser manual on laser mode and burst length.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the SPI tab, set Burst Length to the required value from 0 to 1000000.

9.3.3.10 Setting the pump duty factor

Requirements

- This setting is only applicable if the RS232 interface is used (Laser is operated in laser mode 0 (software mode)) and the laser is operated in CW mode. Please consult the laser manual on laser mode and pump duty factor.

Procedure

1. Edit the SpiGen3 pen-section settings, see [1] chapter Working with Pens.
2. On the SPI tab, set Pump Duty Factor to the required value from 0 to 1000.

9.3.3.11 Operating the pilot laser

Requirements

- Not all SPI laser models are equipped with a pilot laser. Please consult the laser manual on details.

Procedure

1. Edit the SpiGen3 device settings, see [1] chapter Managing Devices.
2. On the Control tab, set Pointing laser to **On** or **Off**.

9.3.3.12 Configuring and viewing the interlocks

Requirement

- To monitor interlocks present in your laser these interlocks have to be connected directly to the GENERAL PURPOSE I/O connector of the ARGES system controller.
- These settings only have an effect when the RS232 or DI-SPA hardware interface is used.

Procedure

The safety shutter, the process shutter and up to 8 interlocks (A to H) can be monitored. They all can be configured in the same way:

1. Edit the SpiGen3 device settings, see [1] chapter Managing Devices.
2. On the Interlocks tab, set the Start condition and Fail condition for the respective interlock.

   Group Status shows the current interlock states and an Error text.

9.3.3.13 Viewing information about the laser state

Procedure

1. Edit the SpiGen3 device settings, see [1] chapter Managing Devices.
2. On the SPI tab, several status information are shown. Please consult the laser manual for more information.

   Laser ready shows if the laser is ready for emission or not. This field does not apply if the laser is connected via the GLA interface.

   In this case this field will always show Unknown.

   Power supply shows if the laser's power supply voltage is in range or out of range. This field does only apply if the laser is connected via the SPA_Laser_1 or SPA_Laser_2 interface.

   In all other cases this field will always show Unknown.

   Alarm If the SPI laser is in alarm state then the current alarms will be shown in this field as texts.

   This field does only apply if the laser is connected via the RS232 or DI-SPA interface. In all other cases this field will always be blank.

9.4 Dart

The Dart device is used to drive a DART laser which is connected to the ARGES system controller (ASC) via ARGNET.

9.4.1 Requirements

- The DART laser head's ARGNET interface is connected by an Ethernet patch cable (Cat5 or better) to one of the ASC's 4 ARGNET ports.
- The ASC's Gate signal (set by factory to HSIO 2 at the ASC's LASER interface) and the signal for the modulation of the radiant power (DAC A at the ASC's LASER interface) are used for the respective inputs at the DART laser head's CUSTOMER INTERFACE.

9.4.2 Configuration

TIP

If you purchased a subsystem consisting of a DART laser and an ARGES system controller from Novanta then the respective device driver should already be present and configured due to testing procedures done at Novanta. In this case just check the settings that are done in the following procedure.

In the following procedure consider details from the laser's user manual.

Requirements

- The DART laser is switched on; see procedure further below.

Procedure

1. Create a new Dart device and edit its configuration, see [1] chapter Managing Devices.
2. In ARGNET port, select the ARGNET port to which the DART laser is connected.
3. Activate the Dart device, see [1] chapter Managing Devices.

The Dart device state will stay ”not ready” (gray in InScript’s Navigator view) until the DART hardware is powered up and found on the selected ARGNET port by the ASC and the selected lowest power state is reached.

4. Optionally make the device configuration permanent, see [1] chapter Managing Devices.
5. Edit the Dart device settings, see [1] chapter Managing Devices.
6. On the Dart tab, in group Version info, check the information about the Dart laser.
7. On the Device states tab, set the Lowest state you want to allow, where the power state machine states ready, standby, down and off are mapped as follows:

   ready The laser is ready for emission.

   standby The laser’s emission is suspended.

   down The laser is disabled.

   off The laser may be switched off.
8. Set the Ready to standby timeout, Standby to down timeout and Down to off timeout for state transitions to your requirements.

   Keep in mind that the transition from standby to down can take up to 20 minutes. During this time the DART device will be set to status ”not ready” and the device will be shown gray in the InScript Navigator view.
9. Make the device configuration permanent, see [1] chapter Managing Devices.

9.4.3 Usage

For the following procedures also consider details from the laser’s user manual.

9.4.3.1 Switching on the laser

This section describes how to switch on the chiller, DART power supply, and DART laser head.

Requirements

- The DART laser head, DART power supply, chiller and InScript software have been commissioned.
- The InScript software is running.
- The Dart device is configured.

Procedure

1. For how to perform the following steps in detail consult the chiller manual.
    a) Switch on the chiller.
    b) Check the coolant level.

       The coolant level must be between the maximum and the minimum of the scale.
    c) Check the coolant flow.

       The coolant flow must be above 5 l/min.
    d) Set the coolant temperature to 25 °C.
2. At the DART power supply back panel, switch on the POWER ON/OFF rocker switch.
3. Wait for 5 seconds.
4. At the DART power supply front panel, press the 24 V push button.

   This switches on the 24 V housekeeping voltage for the DART laser head.
5. Insert the key into the key switch.
6. Turn the key clockwise to the ON-position “I”.
7. Press the green start/acknowledge push button.

   Inside the DART power supply, the safety relay clicks when switching on the 48 V voltage to the DART laser head.

   The laser starts up until it reaches the Lowest state that is set on the Device states tab. At state ready the laser is active but does not emit until the shutter is opened and the Gate signal is switched on.

9.4.3.2 Switching off the laser

This section describes how to switch off the DART laser head, DART power supply, and chiller.

Procedure

1. If Gate control is set to External then set Gate control to **Always off** in pen default (systempen) > dart on the Osc tab.

   -OR-

   If Gate control is set to Internal then set Soft gate to **Off** in the dart device on the Dart tab.

2. In the dart device on the Control tab, set Safety shutter to **Closed**.
3. On the Device states tab, set Lowest state to **off**.
4. Wait until the Remaining timeout is 0 s.
5. At the DART power supply front panel, turn the key switch counterclockwise to the OFF position “0”.
6. Remove the key from the key switch.

   This prevents opening the shutter by mistake or without authorization.

7. At the DART power supply back panel, switch off the mains voltage by switching off the POWER ON/OFF rocker switch.

   The DART power supply and the DART laser head are completely switched off now.

8. Switch off the chiller.

9.4.3.3 Assigning the control over radiant power and gate signal

Procedure

1. Edit the Dart device settings, see [1] chapter Managing Devices.
2. Click the **Dart** tab.
3. If you want to control the radiant power via the corresponding hardware line - this is the preferred method because the radiant power can be

changed during a running job by using pens - then set Power control to **External**.

4. Alternatively, if you want to control the radiant power via UART software command then set Power control to **Internal**.
5. If you want to control the gate signal via the corresponding hardware line - this is the preferred method that switches the oscillator, i.e. the laser emission, automatically on and off according to the job that is running. Between jobs, the oscillator, i.e. the laser emission, is switched off - then
   a) Set Gate control to **External**.
   b) Edit the Dart pen-section settings, see [1] chapter Working with Pens.
   c) On the OSC tab, in Gate control, select **Auto**.
6. Alternatively, if you want to control the gate signal manually by setting Soft gate then set Gate control to **Internal**.

9.4.3.4 Setting the frequency divisor

Procedure

1. Edit the Dart pen-section settings, see [1] chapter Working with Pens.
2. On the Osc tab, set the desired frequency divisor in Frequency divisor.

   The range is 2 to 300. Frequency divisor actual on the Dart tab in the Dart device's node properties shows the value that the laser is currently using.

   Note, that the Frequency divisor must match the settings of Pulse picker divisor and Burst pulse count. A warning message will be issued if this is not the case and the new value will not be sent to the laser.

9.4.3.5 Setting the pulse picker divisor

Procedure

1. Edit the Dart pen-section settings, see [1] chapter Working with Pens.

2. On the Osc tab, set the desired pulse picker divisor in Pulse picker divisor.

   The range is 1 to 65536. Pulse picker divisor actual on the Dart tab in the Dart device's node properties shows the value that the laser is currently using.

   Note, that the Pulse picker divisor must match the setting of the Frequency divisor. A warning message will be issued if this is not the case and the new value will not be sent to the laser.

9.4.3.6 Setting the burst pulse count

Procedure

1. Edit the Dart pen-section settings, see [1] chapter Working with Pens.
2. On the Osc tab, set the desired burst pulse count in Burst pulse count.
3. On the Dart tab, set the desired burst pulse count in Burst pulse count.

   The range is 1 to 31. Burst pulse count actual on the Dart tab in the Dart device's node properties shows the value that the laser is currently using.

   Note that the Burst pulse count must match the setting of the Frequency divisor. A warning message will be issued if this is not the case and the new value will not be sent to the laser.

9.4.3.7 Setting the radiant power

Procedure

1. Edit the Dart pen-section settings, see [1] chapter Working with Pens.
2. On the Control tab, set Power to a percentage of maximum radiant power.

   TIP

   Measure the radiant power at different percentages and plot a curve with radiant power over percentage.

9.4.3.8 Switching on and off the laser emission via the hardware gate signal

The Dart device is a class 4 laser product classified according to IEC EN 60825-1:2015-07. Consider specifications from the laser's user manual.

This chapter describes how the gate signal, and therefore the laser emission, can be controlled via the hardware gate signal line; see also Assigning the control over radiant power and gate signal.

Procedure

1. Edit the Dart pen-section settings, see [1] chapter Working with Pens.
2.

   ⚠ CAUTION

   Visible or invisible laser radiation

   Damage to eye or skin

   a) Avoid eye or skin exposure to direct or scattered radiation.

   b) On the OSC tab, select for Gate control one of the following:

   Always off switches off the oscillator, i.e. the laser emission, even if a job is being executed.

   Always on switches on the oscillator, i.e. the laser emission, even if no job is being executed.

   Auto switches the oscillator, i.e. the laser emission, automatically on and off according to the job that is being executed. Between jobs the oscillator, i.e. the laser emission, is off.

9.4.3.9 Switching on and off the laser emission via the software gate

The Dart device is a class 4 laser product classified according to IEC EN 60825-1:2015-07. Consider specifications from the laser's user manual.

This chapter describes how the gate signal, and therefore the laser emission, can be controlled via a software UART command.

This method cannot be used to control the gate signal in real-time by a job which is currently executed. In this case, use the hardware gate signal; see also Assigning the control over radiant power and gate signal.

Procedure

1. Edit the Dart device settings, see [1] chapter Managing Devices.
2. Click the Dart tab.
3.

   CAUTION

   Visible or invisible laser radiation

   Damage to eye or skin

   a) Avoid eye or skin exposure to direct or scattered radiation.

   b) In the field Soft gate, select one of the following:

      off switches off the oscillator, i.e. the laser emission, even if a job is being executed.

      on switches on the oscillator, i.e. the laser emission, even if no job is being executed.

9.4.3.10 Viewing the current internal frequencies

The internally used frequencies of the DART laser can be viewed in the DART device.

Procedure

1. Edit the Dart device settings, see [1] chapter Managing Devices.
2. On the Dart tab, Seeder frequency, Amplifier frequency, and Output frequency show the actual frequencies used internally by the laser.

   The settings for Frequency divisor and Pulse picker divisor influence the Amplifier frequency as well as the Output frequency.

9.4.3.11 Viewing version information

Procedure

1. Edit the Dart device settings, see [1] chapter Managing Devices.
2. On the Dart tab, group Version info shows information about the serial number, version and date of the FPGA, and version and date of the controller.

9.4.3.12 Viewing status information

Procedure

1. Edit the Dart device settings, see [1] chapter Managing Devices.
2. On the Dart tab, group Status shows information about the internal laser status:

   Laser enabled This light is gray when the laser is currently disabled or green when the laser is currently enabled.

   Laser ready This light is gray when the laser is currently not ready for emission or green when it is.

   Interlock This light is green when no interlock is currently active or red when an interlock is active, preventing laser emission.

   Shutter open This light is gray when the laser's shutter is currently closed or green when it is open.

   Gate on This light is gray when the laser gate is currently off (i.e. emission is disabled) or green when it is on (i.e. emission is enabled).

   Emergency stop This light is gray when the laser is not in emergency stop state or red when it is. When the laser is in emergency stop, the 24 V power supply must be disabled and then re-enabled before this error can be reset.

   Chassis temperature warning This light is gray when the chassis temperature of the laser is below the warning level or red if it is above this level.

   Chassis temperature error This light is gray when the chassis temperature of the laser is below the error level or red if it is above this level.

Error This light is gray when the laser has not detected an internal error or red if it has. Note that if the Dart device is in error state, it does not necessarily mean that the DART laser is also in error state. Also note that this light may be red when the device waits for the laser to be enabled.

Chassis temperature The current value of the chassis temperature in °C is shown in this field.

Time wait for laser enable This field shows the already passed time in seconds when waiting for the laser to enable during the power state transition from Down to Standby. This transition can take up to 20 minutes or 1200 seconds.

9.4.3.13 Troubleshooting

Device does not connect to laser 1. Check if the laser is switched on. 2. Deactivate device, set the correct ARGNET port, where the laser is connected to the ASC, and activate the device again.

Laser emission does not automatically switch on and off Check if Gate control is set to External and the Gate signal is connected from the ASC to the laser

9.5 IpgYlp

Use the IpgYlp device to drive a IpgYlp laser connected to the ASC.

9.5.1 Requirements

- The IpgYlp laser has to be properly connected to the ASC via both the DVI laser interface and the UserIo interface. Please note that the IpgYlp laser device uses the outputs 0 to 10 and the inputs 0 to 7 of the UseIo interface. These inputs and outputs are used exclusively by the IpgYlp laser device and cannot be used for other purposes.

  CAUTION

  Possible damage to the laser

  Do not change the voltage settings for the output supply groups corresponding to outputs 0 to 3, outputs 4 to 7 and outputs 8 to 11 in the UserIo device to 24V external. These settings are locked when the IpgYlp device is active but can be changed when the device is inactive and the UserIo device is configured to use the groups. If the laser inputs are supplied with 24V instead of 5V, the laser could possibly be damaged.

  Please note that the power ramping feature of the linepar device can't be used with the IpgYlp device because the laser power setting is not done via the ASC's DAC outputs which is a requirement for the power ramping feature to work.

9.5.2 Configuration

TIP

If you purchased a subsystem consisting of a laser and an ARGE-S system controller from ARGES then the respective device driver should already be present and configured due to testing procedures done at ARGES. In this case just check the settings that are done in the following procedure.

In the following procedure consider details from the laser's user manual.

Procedure

1. Create a new IpgYlp device and edit its configuration, see [1] chapter Managing Devices.
2. If the laser power supply is hosted within the ARGES system controller then select the SPD resource which the device driver shall use to power the laser:
   a) If none is displayed then click **Detect**.

      If a SPD resource is detected then it will be listed. If no device is detected then there will be no feedback on this result.

   b) In SPD port, select both Laser even if there is only 1 laser to supply.
3. Activate the SpiGen3 device, see [1] chapter Managing Devices.
4. On the YLP tab in the device's node properties, in the field Error decoding, select if the laser type you have connected supports 2 or 3 error bits. Please consult the laser's manual for more information on this topic. If you select ignore, all errors of the laser will be ignored by the IpgYlp device.
5. On the Device states tab, set the Lowest state you want to allow, where the power state machine states ready, standby, down and off are mapped as follows:

   ready The laser is ready for emission.

   standby The laser's emission is suspended.

   down The laser is disabled.

   off The laser may be switched off.
6. On the Device states tab, set the Ready to standby timeout, Standby to down timeout and Down to off timeout for state transitions to requirements.
7. Make the device configuration permanent, see [1] chapter Managing

Devices.

9.5.3 Usage

For the following procedures consider details from the laser's user manual.

9.5.3.1 Setting the optical laser power

Procedure

1. Edit the IpgYlp pen-section settings, see [1] chapter Working with Pens.
2. On the Control tab, set Power to a percentage of maximum power.

   TIP

   Measure the optical laser power at different percentages and plot a curve with power over percentage.

9.5.3.2 Switching on and off the laser emission

The IpgYlp device is a class 4 laser product classified according to IEC EN 60825-1:2015-07. Consider specifications from the laser's user manual.

Procedure

1. Edit the IpgYlp pen-section settings, see [1] chapter Working with Pens.
2. **CAUTION**

   Visible or invisible laser radiation

   Damage to eye or skin

   a) Avoid eye or skin exposure to direct or scattered radiation.

   b) On the OSC tab, select for Gate control one of the following:

      Always off switches off the oscillator, i.e. the laser emission, even if a job is being executed.

Always on switches on the oscillator, i.e. the laser emission, even if no job is being executed.

Auto switches the oscillator, i.e. the laser emission, automatically on and off according to the job that is being executed. Between jobs the oscillator, i.e. the laser emission, is off.

9.5.3.3 Setting the pulse repetition rate

The pulse repetition rate (pulse frequency) controls how many pulses the laser emits per second.

Procedure

1. Edit the IpgYlp pen-section settings, see [1] chapter Working with Pens.
2. On the Osc tab, set Frequency to the required value.

9.5.3.4 Operating the pilot laser

Procedure

1. Edit the IpgYlp device settings, see [1] chapter Managing Devices.
2. On the Control tab, set Pointing laser to **On** or **Off**.

10 Devices: Sensor

WFIBase

10.1 WFIBase

The WFIBase Device manages a WFI-OCT hardware component built into the ASC. The WFI-OCT allows the user to monitor the correct execution of the laser process.

10.1.1 Requirements

- The ASC has to be equipped with a WFI-OCT hardware component.

10.1.2 Configuration

To show image data in InScript (AScan, BScan), InScript needs to be configured to receive the AScan- and BScan-image streaming data.

Requirements

- The PC which runs InScript has to be equipped with a dedicated network card to receive the image streaming data of the WFI-OCT.

Procedure

Ensure that the eth1 interface of the ASC and the PC are in the same network, e.g. `10.0.0.10` and `10.0.0.52`. Also pay attention to the configuration of the netmask:

1. On the ASC, configure the IP address of the Ethernet interface eth1 via

the InScript controller services, e.g. `10.0.0.10` for the IP and `255.255.255.0` for the netmask.

2. Restart the ASC.
3. On the PC, configure the IP address of the dedicated ethernet adapter for receiving the WFI-OCT image streaming data, e.g. `10.0.0.52` for the IP and `255.255.255.0` for the netmask.
4. In the InScript software, configure the WFIViews plugin to use the correct IP address of the ASC eth1 interface and the IP address of the PC's dedicated network card. Please consult the InScript manual.
5. In the InScript software, create a new WFIBase device and edit its configuration; see also [1] chapter Managing Devices.
6. In InScript IP Mac, select the combination of IP- and Mac-address that you want to send image streaming data to.

   This information can be retrieved e.g. in the windows command prompt `cmd.exe` with the command `ipconfig /all`. Use the IP and MAC address of the Ethernet adapter from which the PC is connected to the eth1 port of the ASC.

10.1.3 Usage

10.1.3.1 Activating the device

Requirements

- The device is configured as described above.

Procedure

- Activate the WFIBase device; see also [1] chapter Managing Devices.

  If the WFIBase device is activated for the first time after a boot of the ASC, the reference arm will be initialized.

  This will take about 45 seconds. The WFIBase device will be shown as not ready in InScript during this time (gray light in the navigator window) and will be shown as ready again (green light in the navigator window) once the initialization is done.

The WFIBase device's power state defines if measurement is running or not. The power state can be set in the Device states tab in the group Power with the value Lowest state. If the lowest state is set to ready the measurement will be active.

In all other states, the measurement will not be active. Some settings in the WFIBase device can only be changed if the measurement is not active (e.g. Signal processing).

By default, the WFIBase device will be set to power state standby if it is activated manually by the user.

However if another power state is set and the configuration is saved then the WFIbase device will start in the saved power state when the firmware is booted up.

10.1.3.2 Starting/stopping measurement without external trigger

If measurement is started in the WFIBase device without external trigger then the WFI-OCT will immediately start measuring and sending data, regardless if a job is running or not. This is called ”free-run” mode.

Procedure

1. Edit the wfibase device settings, see [1] chapter Managing Devices.
2. On the Device states tab, in the group Power, set the Lowest state to standby.
3. On the Control tab, check the **Interlock** status.

   If it is Active then reset the interlock to Inactive by clicking **Acknowledge**.
4. Check the status of the Reference arm.

   If it is Not initialized then click **Initialize** and wait until the status shows On position. If it is Is moving then just wait until the status shows On position.
5. Deactivate **External trigger**.
6. Deactivate **Testimage generator**.

7. If the AScan data shall be transformed via Fourier transformation into an evaluable signal then activate **Signal processing**.
8. To start the measurement and the transmission of WFI-OCT data, change to the Device states tab and in the group Power set the Lowest state to ready.

   To stop the measurement, in the group Power, set the Lowest state to a value lower than ready, e.g. standby.

10.1.3.3 Starting/stopping measurement with external trigger

If measurement is started in the WFIBase device with external trigger then the WFI-OCT will only start measuring and sending data when a job with a WFI node is started.

Requirements

- A job which contains a WFI node has to be selected.

Procedure

1. Edit the wfibase device settings, see [1] chapter Managing Devices.
2. On the Device states tab, in the group Power, set the Lowest state to standby.
3. On the Control tab, check the Interlock status.

   If it is Active then reset the interlock by clicking **Acknowledge**.
4. Check the status of the Reference arm.

   If it is Not initialized then click **Initialize** and wait until the status shows On position. If it is Is moving then just wait until the status shows On position.
5. To enable external triggering, activate **External trigger**.
6. Deactivate **Testimage generator**.
7. If the AScan data shall be transformed via Fourier transformation into an evaluable signal then activate **Signal processing**.
8. If the WFIBase device is currently set to unmanaged then set it to man-

aged.

9. To start the measurement and the transmission of WFI-OCT data, just start a job that contains a WFI job node.

   The power state as seen in the field Current state in the group Power on the Device states tab will be set to ready and the WFI-OCT measurement will be started.

   If the job is aborted or completed without error, the WFI-OCT measurement will be stopped and the power state will be reset to the value set before the job was started.

10.1.3.4 Starting/stopping measurement with test pattern

Requirements

- The PC which is used to receive image streaming data has to be connected via Ethernet to the eth1 interface of the ASC.
- The Ethernet configurations on the PC and the ASC have to be correct; see section Configuration.

Procedure

1. Edit the wfibase device settings, see [1] chapter Managing Devices.
2. On the Device states tab, in the group Power, set the Lowest state to standby.
3. On the Control tab, check the Interlock status.

   If it is Active then reset the interlock by clicking **Acknowledge**.
4. Check the status of the Reference arm.

   If it is Not initialized then click **Initialize** and wait until the status shows On position. If it is Is moving then just wait until the status shows On position.
5. Activate **Testimage generator**.
6. Activate **Image streaming**.
7. Deactivate **Signal processing**.

8. Deactivate **External trigger**.
9. To start the measurement and the transmission of WFI-OCT image data with a test pattern, change to the Device states tab and in the group Power, set the Lowest state to ready.

   In the BScan view, diagonally moving black, gray and white lines will be shown.

   To stop the measurement, in the group Power, set the Lowest state to a value lower than ready, e.g. standby.

10.1.3.5 Starting/stopping measurement with image streaming in free-run mode

In free-run mode, WFI-OCT image data will always be transmitted when the measurement is running, regardless if a job is running or not.

Requirements

- The PC which is used to receive image streaming data has to be connected via Ethernet to the eth1 interface of the ASC.
- The Ethernet configurations on the PC and the ASC have to be correct; see section Configuration.

Procedure

1. Edit the wfibase device settings, see [1] chapter Managing Devices.
2. On the Device states tab, in the group Power, set the Lowest state to standby.
3. On the Control tab, check the Interlock status.

   If it is Active then reset the interlock by clicking **Acknowledge**.
4. Check the status of the Reference arm.

   If it is Not initialized then click **Initialize** and wait until the status shows On position. If it is Is moving then just wait until the status shows On position.
5. Activate **Image streaming**.

6. Deactivate **External trigger**.
7. Deactivate **Testimage generator**.
8. If the AScan data shall be transformed via Fourier transformation into an evaluable signal then activate **Signal processing**.
9. To start the measurement and the transmission of WFI-OCT data with AScan and BScan image data, change to the Device states tab and in the group Power, set the Lowest state to ready.

   To stop the measurement, in the group Power, set the Lowest state to a value lower than ready, e.g. standby.

10.1.3.6 Starting/stopping measurement with image streaming in external trigger mode

In external trigger mode, WFI-OCT image data will only be transmitted when both the measurement and a job with a WFI node are running.

Requirements

- The PC which is used to receive image streaming data has to be connected via Ethernet to the eth1 interface of the ASC.
- The Ethernet configurations on the PC and the ASC have to be correct; see section Configuration.

Procedure

1. Edit the wfibase device settings, see [1] chapter Managing Devices.
2. On the Device states tab, in the group Power, set the Lowest state to standby.
3. On the Control tab, check the Interlock status.

   If it is Active then reset the interlock by clicking **Acknowledge**.
4. Check the status of the Reference arm.

   If it is Not initialized then click **Initialize** and wait until the status shows On position. If it is Is moving then just wait until the status shows On position.

5. Activate **Image streaming**.
6. Activate **External trigger**.
7. Deactivate **Testimage generator**.
8. If the AScan data shall be transformed via Fourier transformation into an evaluable signal then activate **Signal processing**.
9. If the WFIBase device is currently set to unmanaged then set it to managed.
10. To start the measurement and the transmission of WFI-OCT AScan and BScan image streaming data data, just start a job that contains a WFI job node.

    The power state as seen in the field Current state in the group Power on the Device states tab will be set to ready and the WFI-OCT measurement will be started.

    If the job is aborted or completed without error, the WFI-OCT measurement will be stopped and the power state will be reset to the value set before the job was started.

10.1.3.7 Setting the CCD offset parameters

The CCD offset parameters are needed to convert the raw distance values from the WFI-OCT into distance in millimeter. This is needed for the topology viewer and for the threshold monitor. One individual offset exists for each position slot.

Procedure

1. Edit the wfibase device settings, see [1] chapter Managing Devices.
2. On the Configuration tab, set the desired Offset values for each position slot.

   Calculation: `distance[px] * scaling[mm/px] + Offset`

10.1.3.8 Setting the WFI-OCT trigger frequency

The WFI-OCT trigger frequency defines the number of AScan triggers per second when the WFI-OCT is used in external trigger mode.

This setting does not have any effect in free-run mode.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, set the desired **Trigger frequency** in Hz. The allowed range is 1 to 64000 Hz.

10.1.3.9 Setting the WFI-OCT trigger delay

The WFI-OCT trigger delay defines the delay between switching on and off the process laser and switching on and off the WFI-OCT measurement when the WFI-OCT is used in external trigger mode.

This setting does not have any effect in free-run mode.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, set the desired **Trigger delay** in µs.

10.1.3.10 Setting the position slot

Different position slots have different height ranges where they get a good signal. The slot can be changed on-the-fly during an active job.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, select the desired **Position slot**.

10.1.3.11 Setting the SLD power

The SLD power can be changed while a job is running via a pen-able parameter. It affects the brightness regarding the AScan.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, in Power, enter the desired power value of the SLD as a percentage.

10.1.3.12 Setting the integration time

The integration time is the exposure time of one AScan. This time can be changed on-the-fly during an active job.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, in Integration time, enter the desired integration time value in microseconds.

   If the WFI-OCT is running in free-run mode (external trigger is disabled) then the maximum allowed integration time value is 65 microseconds. In external trigger mode, the maximum allowed value depends on the configured WFI-OCT trigger frequency, but may also never be greater than 65 microseconds. Otherwise, the maximum allowed value in external trigger mode is the time distance between 2 AScans for the configured trigger frequency. So, for example, if a trigger frequency of 40000 Hz is used, then the maximum allowed integration time is 25 microseconds.

10.1.3.13 Setting the scaling value

The scaling value defines how much of the lower part of the AScan will be cut to reduce noise. This value can be changed on-the-fly during an active job.

Requirements

- Setting the Scaling value will only have an effect if Signal processing is enabled in the WFI-OCT device settings.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, in Scaling value, enter the desired scaling value.

10.1.3.14 Setting the image width

The image width defines the width (=number of depth values) of the BScan image. This value can be changed on-the-fly during an active job.

Requirements

- Setting the Image width will only have an effect if Signal processing is enabled in the WFI-OCT device settings.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, in Image width, select the desired image width.

10.1.3.15 Setting the image height

The image height defines the height (= number of AScans) of the BScan image.

Requirements

- Although Image height is a pen-able value, this value cannot be changed during an active measurement at the moment.

Procedure

1. If a measurement is running then stop it as described further above.
2. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.

3. In the Measurement configuration group, in Image height, select the desired image height.
4. Start the measurement as described further above.

10.1.3.16 Setting the highpass cutoff index

The highpass cutoff index defines the number of pixels within a BScan which will be ignored and will be black within the BScan viewer.

The reason for this is that there can be quite some signal noise in the area which decreases the BScan quality.

Requirements

- Setting the Highpass cutoff index will only have an effect if Signal processing is enabled in the WFI-OCT device settings.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. In the Measurement configuration group, in Highpass cutoff index, enter the desired value.

10.1.3.17 Monitoring the laser process with the threshold manager

The threshold manager (THM) is used to monitor the process. There are 2 criteria: the signal-to-noise ratio and the absolute distance from Z=0. Only if the signal-to-noise ratio is good, you can check the absolute distance from Z=0. Each threshold is valid only if within an Interval at most Sensitivity pixels are invalid:

signal-to-noise ratio If the signal-to-noise ratio is below the Threshold then the THM is waiting for a valid signal.

If the signal-to-noise ratio is above the Threshold then the THM is active. After activation, if the signal signal-to-noise ratio falls below the threshold then the THM stops the current job execution and deactivates the measurement. The state is Stop via SNR then.

absolute distance from Z=0 If the THM is active then the absolute distance from Z=0 is checked. If the distance rises above or falls below the threshold (depending on configuration) then the THM stops the current job execution and deactivates the measurement. The state is Stop via LOCALMAX then.

Requirements

- A job, which contains a WFI node, has to be selected.

Procedure

1. Edit the wfibase pen-section settings, see [1] chapter Working with Pens.
2. To enable the threshold manager, activate **Stop process at...**

   The threshold manager will only be active while a job is running. As soon as the THM triggers, the currently running job will be aborted.
3. Set the parameters for signal-to-noise ratio as shown:

   Threshold gives the threshold for a valid SNR value.

   Interval number of AScans checked to measure if the current threshold is valid.

   Sensitivity number of AScans within Interval who may be invalid without making the whole interval invalid.
4. Set the parameters for absolute distance from Z=0 as shown:

   Threshold gives the threshold for a valid distance value.

   Interval number of AScans checked to measure if the current threshold is valid.

   Sensitivity number of AScans within Interval who may be invalid without making the whole interval invalid.

   Comparison select selects if the job is aborted when the distance value rises above (greater than Threshold) or falls below (less than Threshold) the configured threshold.

11 Devices: Scanhead

DgBb

Dist_xy

Head

Linepar

11.1 DgBb

Use the DgBb device to monitor a DgBb digital scan head. The DgBb device can be helpful for our support team.

11.1.1 Configuration

Requirements

- A DgBb scan head with HSSI interface is connected to the Data A interface at the ARGES system controller.

  -OR-

  A DgBb scan head with ARGnet interface is connected to the ARN0 interface at the ARGES system controller.
- The scan head is connected to the SCAN HEAD POWER interface at the ARGES system controller.
- The system has been power cycled.

Procedure

1. Create a new DgBb device and edit its configuration, see [1] chapter Managing Devices.

2. In Resource select the Device the driver shall be assigned to.

   If none is the only available device in the list then click **Detect**.

   If no device is detected, please check cabling and, only for HSSI scan heads, power cycle the system.

3. Activate the device, see [1] chapter Managing Devices.

   Activating the device will take up to 1 minute.

4. Wait until the device is fully activated.

5. Make the device configuration permanent, see [1] chapter Managing Devices.

11.1.2 Usage

After activating the DgBb device, you can watch measurements of the internal parameters. The DgBb device monitors the error states of the DgBb scan head.

11.1.2.1 Error handling

If one of the galvo drivers or the main system detects an error then the DgBb device will go into failure state. If the DgBb device is managed and a job is running then the job will be aborted.

Note that the Overtemperature in the galvo sections is only a warning unless the Fault is also set.

In case of an internal error, the Error log displays a list of error codes.

You can try to **Reset** the device to exit the failure state. If the problem persists then the device will raise an error again.

11.1.2.2 Displaying general information

Procedure

1. In the InScript software in the Navigator window, open the **DgBb** device.

2. Click the **General** tab.

   This tab shows general information about the DgBb board of the scan head.

11.1.2.3 Displaying information about the galvos

Procedure

1. In the InScript software in the Navigator window, open the **DgBb** device.
2. Click one of the **DGI 0** to **DGI 3** tabs.

   These tabs show internal information from up to 4 digital galvo interface boards in the DgBb scan head.

11.2 Dist_xy

The dist_xy device holds variables for the correction of the scan head's scan field distortion.

11.2.1 Configuration

The dist_xy device cannot be deactivated as it is essential for the scan head's operation. Thus the dist_xy device cannot be configured like other devices.

11.2.2 Usage

The dist_xy device has a graphical user interface that allows only to view some basic parameters of the scan field correction in use.

⚠ CAUTION

Editing variables via the Inspector

may result in loss of data.
Use the Manage Scan Field Correction wizard instead:

1. In the Navigator window in the respective ARGES system controller's context menu, click **Manage scan field correction**.
2. In the Manage scan field correction wizard, click **Info** to open the on-screen documentation.

11.3 Head

The head device drives Novanta scan heads.

11.3.1 Configuration

The head device cannot be deactivated as it is essential for the scan head's operation. Thus, the head device cannot be configured like other devices.

11.3.2 Usage

11.3.2.1 Setting the wobbling (superimposing the laser beam trajectory with a circular movement)

For some applications, the line width created directly by the laser beam is too narrow. For this reason, the laser beam trajectory can be superimposed with a circular, oval, sinusoidal, or eight-shaped movement, the so-called wobble. That way the resulting line width can be widened.

Procedure

1. Edit the head pen-section settings, see [1] chapter Working with Pens.
2. On the Wobble tab, set the following parameters:

   Height sets the wobble height.

   Width sets the wobble width. This setting has only an effect if the Type is configured to oval.

   Frequency sets the wobble frequency.

   Phase sets the angle for parallel projection of the wobble circle.

   Angle sets the projection plane direction.

   Type selects whether the wobble function is disabled or its output is circular, oval, sinus or eight shaped.

   Direction selects the direction of the wobble either to clockwise or counterclockwise.

3. Check if the output meets your needs.
4. Make the device configuration permanent, see [1] chapter Managing Devices.

11.3.2.2 Setting a home position between job execution

Setting the position in the scan field where the scan head points to, when no job is being executed, is used e.g. when optical laser power is leaking through and the workpiece has to be protected.

Procedure

1. Edit the head device settings, see [1] chapter Managing Devices.
2. On the Configuration tab, set the Home position for the X axis and Y axis.
3. Check if the output meets your needs.
4. Make the device configuration permanent, see [1] chapter Managing Devices.

11.3.2.3 Configuring the head device for the use of HSSI scanheads

The ASC Gen4 can be used to drive HSSI scanheads. This section describes the necessary configuration in the head device to use such scanheads.

Requirements

1. The HSSI scanhead must be connected to the ASC's HSSI data A port and must be supplied by a suitable external power supply.

Procedure

1. Edit the head device settings, see [1] chapter Managing Devices.
2. On the Configuration tab, set the Interface type to HSSI.
3. In the group HSSI settings, set the Number of subframes field to the correct value for the used HSSI scanhead type. This is usually 2 for 2D scanheads, 4 for 3D scanheads and 6 for PE2 scanheads.

4. In the fields TX scale subframe 0 to TX scale subframe 7, set the correct TX scaling values for all used subframes of the used scanhead type. These values define the maximum range of the actuator which is mapped to the corresponding subframe, either in degrees or in millimeters, depending on the type of actuator (degrees for rotary actuators, millimeters for linear actuators).
5. In the fields RX scale subframe 0 to RX scale subframe 7, set the correct RX scaling values for all used subframes of the used scanhead type. These values are only used for the backchannel data, i.e. for the TrackedActuatorPositionPEM0123Z, TrackedActuatorPositionXYZ and TrackedScannerPositionXYZ timed signal streams. The values define the maximum range of the actuator which is mapped to the corresponding subframe, either in degrees or in millimeters, depending on the type of actuator (degrees for rotary actuators, millimeters for linear actuators) and are usually larger than the corresponding TX values. The values can vary slightly between individual scanheads.
6. Make the device configuration permanent, see [1] chapter Managing Devices.
7. Restart the firmware or reboot the ASC.

11.4 Linepar

The linepar (line parameter) device summarizes parameters needed for line handling.

11.4.1 Configuration

The linepar device is always activated and cannot be deactivated as it is essential for the scan head’s operation. Thus the linepar device cannot be configured like other devices.

11.4.2 Usage

11.4.2.1 Setting the scan head’s processing speed

Procedure

1. In the Navigator view, expand **Pens** → **default (systempen)** and click **linepar**.
2. On the tab Common set the value Processing speed to the desired scan head processing speed value of your process.

11.4.2.2 Setting the handling of joint-types, open ends and dots

Galvanometers move the mirrors in the deflection system. A nominal position is transmitted to the galvanometers. An analog PID-regulator controls the nominal position. The galvanometer-mirror-system has an inertia. Therefore, at high speeds, the deflected laser beam lags behind the nominal position with the value of the tracking error. Additional errors exist, e.g. as the laser beam cannot be switched on and off instantly. These errors cause a result with inadequate quality. ARGES deflection systems correct these errors using several special methods.

Procedure

1. In the Navigator view, expand **Pens** → **default (systempen)** and click **linepar**.
2. On tabs Common and Times, set the parameters convenient to your process.

   The following explains these parameters.

Linehandling mode The Linehandling mode defines the general type of linehandling which is used by the firmware to generate transitions between lines. When the Linehandling mode is set to Actuator LH then the firmware automatically determines the speeds and laser on/off times for the transitions depending on the capabilities of the scanhead. If the mode Cartesian LH is used, then the user can define the speeds and the laser on/off times for the transitions manually. All settings regarding joint 1, joint 2 (only exception: Min. angle for joint2) and open end are only taken into account when the linehandling mode Cartesian LH is used.

Head and Tail If a line is output between points A and B then the firmware defines 2 additional points A' and B'. These points are on the extensions of the line in both directions. The distance [A'A] is called Head. The distance [BB'] is called Tail.

Figure 11.1: Head and Tail

Legend of figure 11.1 on page 165 : (1) Head, (2) Tail

To draw a line from A to B the system needs to move the distance between A' and B'. This is because the scan head needs the distance [A'A] to accelerate to the specified processing speed. The difference between nominal and actual position is system specific and called tracking error.

On delay and Off delay The laser beam must not be switched on until point A is crossed by the nominal position plus the tracking error. Therefore the laser beam has to be switched on with a delay that corresponds to the tracking error. This delay is called the On delay. Corresponding to that the laser beam must not be switched off until point B is crossed by the nominal position plus the tracking error. This delay is called the Off delay. This means that On delay and Off delay should be positive and equal in value. In practice the laser beam switch on and off delays (e.g. the shutter delay) have to be taken into account too. As these delays may differ, the optimal values for On delay and Off delay also may differ. The On delay and Off delay values are only taken into account if the Cartesian LH linehandling mode is used, otherwise these values are automatically determined by the ASC.

Joint types To make optimal output of lines and polygons possible it is necessary to distinguish between several line types. Most of the outlines are approximated by polygons in practice, e.g. rectangles and circles, are represented by a sequence of lines, where the end point of the first line is the start point of the second line, the end point of the second line is the start point of the third line and so on. The angle between the continuation of the pre-joint line and the post-joint line is between 0° and 180°.

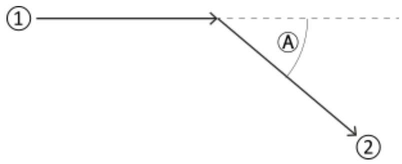


Figure 11.2: Angle in change of direction

Legend of figure 11.2 on page 166 : (1) Pre-joint line, (2) Post-joint line, (A) Angle

Depending on this angle, the joint in a polygon will be output with 1 of 3 methods. These methods correspond to the types of joints Normal joint, Joint 1 and Joint 2. In addition there are the types Open end and Dot. The following paragraphs only describe the types Joint 2 and Dot because no settings have to be done for the other types.

Normal joint At a Normal joint the end point of the pre-joint line coincides with the start point of the post-joint line. As long as the angle for the change of direction is obtuse, it is not necessary to correct the path by setting the times for Head and Tail. The laser beam is not switched off along such joints.

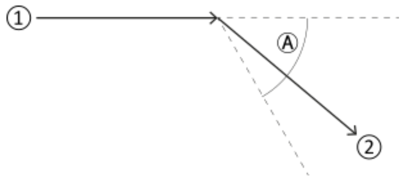


Figure 11.3: Joint type: Normal joint

Legend of figure 11.3 on page 167 : (1) Pre-joint line, (2) Post-joint line, (A) Min angle for joint 1

Joint 1 At Joint 1 type the end point of the pre-joint line coincides with the start point of the post-joint line. At angles for the change of direction in the range between Min angle for joint 1 and Min angle for joint 2 the path has to be corrected by setting a Tail time. Thus the time is taken into account that is needed until the actual laser beam position reaches the start point of the next line. The laser beam is not switched off along such joints. The Min angle for joint 1 value is not taken into account when the linehandling mode is set to Actuator LH, in this case, it is automatically determined by the ASC.

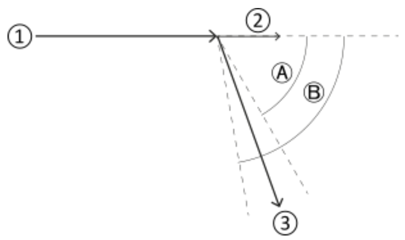


Figure 11.4: Joint type: Joint 1

Legend of figure 11.4 on page 167 : (1) Pre-joint line, (2) Tail, (3) Post-joint line, (A) Min angle for joint 1, (B) Min angle for joint 2

Joint 2 At Joint 2 type the end point of the pre-joint line coincides with the start point of the post-joint line. The minimum angle for the joint 2 handling to occur has to be set in the variable Min angle for joint 2. At acute angles for the change of direction the path will be corrected with Head and Tail times. Those times are determined automatically by the ASC and the scan head if the linehandling mode is set to Actuator LH, otherwise those values have to be set by the user. When the end point B’ of the pre-joint line is reached, the nominal position is set to the start point A’ of the post-joint line. The laser beam is switched off, as soon as the point is reached on Off delay and switched on again, when the nominal position reaches the point at On delay. The times for On delay and for Off delay are automatically determined by the ASC if the linehandling mode is set to Actuator LH, otherwise those values have to be set by the user. Joint 2 is a succession of lines of type Open end.

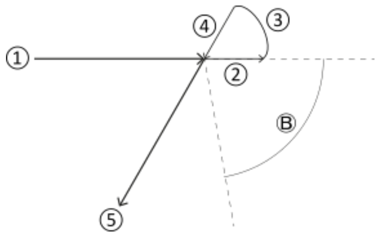


Figure 11.5: Joint type: Joint 2

Legend of figure 11.5 on page 168 : (1) Pre-joint line, (2) Tail, (3) Jump line, (4) Head, (5) Post-joint line, (B) Min angle for joint 2

Open end At an Open end line the end point does not coincide with the start point of another line. Times for Head and Tail as well as the On delay and Off delay have to be set if the Cartesian LH linehandling mode is used, otherwise these values are automatically determined by the ASC.

Dot A Dot is a special case of line. Points A and B are at the same position. The laser beam stays on at this position for the On-time. Times for Head (Pre-delay) and Tail (Post-delay) as well as the On-time have to be set.

11.4.2.3 Setting the laser output power ramping

Laser output power ramping is mainly used to prevent e.g. excessive material removal or scorching while cutting or welding and when the laser output overlaps.

Requirement

The laser has to be connected to one of the ASC system controller’s DAC (Digital to Analog Converter) outputs, otherwise settings on this tab have no effect.

Procedure

1. In the Navigator view, expand **Pens** → **default (systempen)** and click **linepar**.
2. On tab Ramping, set the parameters convenient to your process.

   The following explains these parameters.

Mode selects the laser output power setting either from the laser driver (None) or from this tab (Linear multiplying).

Specification selects if the duration of the rising or falling ramp is defined by time (set with parameters Rise time and Fall time) or by length (set with parameters Rise length and Fall length). This can be selected separately for the rising and falling ramp.

further parameters are illustrated in figure 11.6 on page 169 . Please note that all power values on this tab are relative to the power value set in the laser device. The power values of the ramps will be output in 1 ms steps.

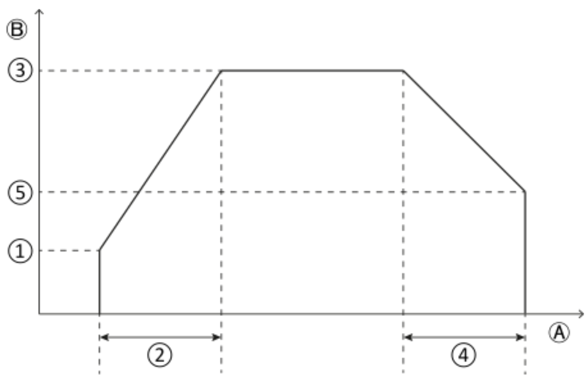


Figure 11.6: Terminology in laser output power ramping

Legend of figure 11.6 on page 169 : (A) Time in milliseconds or Length in millimeters, (B) Percentage of laser output power, (1) Start power factor, (2) Rise time or Rise length, (3) Power factor, (4) Fall time or Fall length, (5) End power factor

11.4.2.4 Using the poly delay feature

When polygons are output, the galvos inside the scan head can make abrupt turns, which can generate undesired arcs. The poly delay feature can be used to compensate for these arcs by introducing delays in the commanded scan head position stream at those turns. The delay gives the galvos inside the scan head more time to reach the target destination before the next vector segment is output.

Normally the amount of time required to reach the target destination is proportional to the angular change between successive vector segments. Smaller angles require less time, and larger angles require more time. This proportionality is automatically managed when delay scaling is enabled.

Procedure

1. In the Navigator view, expand **Pens** → **default (systempen)**.
2. Click **linepar**.
3. On the Poly Delay tab, set the parameters convenient to the desired poly delay configuration:

Delay sets the poly delay time in microseconds. The value 0 disables the poly delay feature.

Enable delay scaling If this is activated, then the delay time will be automatically adjusted proportionally to the angular change of the vector segments. The scaling is done using a raised cosine function as shown in the figure below.

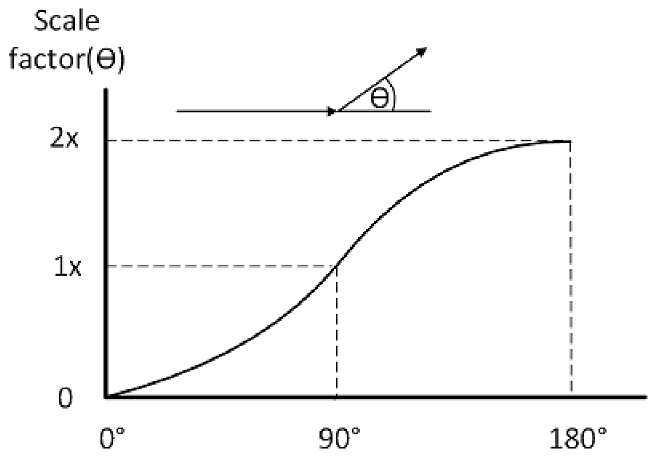


Figure 11.7: Raised cosine function used for poly delay scaling

12 Devices: IOControl

EtherCAT

UserIo

PlcDiag

12.1 EtherCAT

If the ARGES system controller is equipped with the WFI-OCT hardware, then the ethercat device can be used to transmit WFI-OCT A-Scan local max values, position data and B-Scan summary data from the WFI-OCT hardware to devices outside the ARGES system controller via EtherCAT. Optionally the ethercat device interfaces the ARGES system controller to a EtherCAT master device for the purpose of job control. In addition to this, general purpose inputs and outputs (16 each) can be transmitted/received via EtherCAT.

12.1.1 Configuration

12.1.1.1 Configuration of the EtherCAT master for use with the ASC

Requirements

1. The ARGES system controller has to be equipped with a EtherCAT adapter board.
2. An EtherCAT master device has to be connected to the ETHERCAT IN connector at the ARGES system controller. Please consult the manual of the EtherCAT master software for more information on how to install and configure EtherCAT devices.

Procedure

1. Supply the EtherCAT master with the ASC’s EtherCAT slave information (ESI) file.
2. Add the ”ASC ARGNET series” device to the EtherCAT master network configuration
3. Set the EtherCAT master to PreOP state

   Note

   The following information regarding PDO configuration is only valid if the EtherCAT revision number is 3 or higher. If the EtherCAT revision number is 1, there is only one TxPDO (0x1A00) and one RxPDO (0x1600) in a fixed EtherCAT frame. In this case, the TxPDO 0x1A00 will contain the ”PLC state data” and the ”WFI-OCT B-Scan summary data” and the RxPDO 0x1600 will contain the ”PLC control data” described below. The data from all other PDOs described below can not be used in this case.

4. In the EtherCAT master’s PDO configuration, select the TxPDOs and RxPDOs you want to use.

   The ASC offers the following TxPDOs:

   0x1A00 PLC state data

   0x1A01 GPIO output data

   0x1A02 WFI-OCT B-Scan summary data

   0x1A03 WFI-OCT A-Scan position data

   0x1A10 WFI-OCT A-Scan localmax data 1

   0x1A11 WFI-OCT A-Scan localmax data 2

   The ASC offers the following RxPDOs:

   0x1600 PLC control data

   0x1601 GPIO input data

   Description of TxPDOs:

   PLC state data PDO (0x1A00)

   This PDO contains 32 bits of PLC state data which are encoded as following:

Bit 0 Devices awake

Bit 1 Devices failure

Bit 2 Devices ready

Bit 3 Devices setup

Bit 4 Job ready

Bit 5 Job active

Bit 6 Job completed

Bit 7 Job failed

Bit 8 System safe

Bit 9 Job paused

Bit 10 Job piloted

Bit 11 Job preloaded

Bit 12 Job stopping

Bit 13 Ready for power off

Bit 14 System ready

Bit 15 Attention

Bit 16 System safe request

Bit 17 Job preloaded

all other bits reserved, not used

See also section Optionally connecting a programmable logic controller in the ARGES system controller manual.

GPIO output data PDO (0x1A01)

This PDO contains 32 bits of general purpose outputs. These outputs can be set in the ethercat device's node properties as described in the chapter Setting general purpose outputs below.

WFI-OCT B-Scan summary data (0x1A02)

This PDO is only of use together with the WFI-OCT hardware. If the ASC does not have the WFI-OCT hardware, then please don't use this PDO.

The PDO contains 28 bytes of summary data for each WFI-OCT B-Scan which are encoded as following:

Bytes 0..1 WFI-OCT B-Scan framecounter (16 bits, type UINT)

Bytes 2..5 WFI-OCT B-Scan 125 MHz timestamp (32 bits, type UDINT)

Bytes 6..9 WFI-OCT B-Scan scanhead position X (32 bits, type REAL)

Bytes 10..13 WFI-OCT B-Scan scanhead position Y (32 bits, type REAL)

Bytes 14..17 WFI-OCT B-Scan scanhead position Z (32 bits, type REAL)

Bytes 18..21 WFI-OCT B-Scan base reflection area distance (32 bits, type DINT)

Bytes 22..23 WFI-OCT B-Scan wedge position (16 bits, type INT)

Bytes 24..27 WFI-OCT B-Scan signal-to-noise ratio (32 bits, type UDINT)

As the EtherCAT data are updated every 4 ms, if B-Scans occur faster than every 4 ms, then summary data cannot be transmitted for every B-Scan.

WFI-OCT A-Scan position data PDO (0x1A03)

This PDO is only of use together with the WFI-OCT hardware. If the ASC does not have the WFI-OCT hardware, then please don't use this PDO.

This PDO contains position data together with timestamps for every 128th WFI-OCT A-Scan of which the local max data can be found in TxPDOs 0x1A04 and 0x1A05.

Elements of this PDO:

Bytes 0..3 WFI-OCT A-Scan 1 125 MHz timestamp (32 bits, type UDINT)

Bytes 4..7 WFI-OCT A-Scan 1 scanhead position X (32 bits, type REAL)

Bytes 8..11 WFI-OCT A-Scan 1 scanhead position Y (32 bits, type REAL)

Bytes 12..15 WFI-OCT A-Scan 1 scanhead position Z (32 bits, type REAL)

Bytes 16..19 WFI-OCT A-Scan 129 125 MHz timestamp (32 bits, type

UDINT)

Bytes 20..23 WFI-OCT A-Scan 129 scanhead position X (32 bits, type REAL)

Bytes 24..27 WFI-OCT A-Scan 129 scanhead position Y (32 bits, type REAL)

Bytes 28..31 WFI-OCT A-Scan 129 scanhead position Z (32 bits, type REAL)

Bytes 32..35 WFI-OCT A-Scan 257 125 MHz timestamp (32 bits, type UDINT)

Bytes 36..39 WFI-OCT A-Scan 257 scanhead position X (32 bits, type REAL)

Bytes 40..43 WFI-OCT A-Scan 257 scanhead position Y (32 bits, type REAL)

Bytes 44..47 WFI-OCT A-Scan 257 scanhead position Z (32 bits, type REAL)

WFI-OCT A-Scan localmax data 1 PDO (0x1A10)

This PDO is only of use together with the WFI-OCT hardware. If the ASC does not have the WFI-OCT hardware, then please don't use this PDO.

This PDO contains local maximum values for 255 WFI-OCT A-Scans. The local max values for further 129 A-Scans can be found in TxPDO 0x1A11.

Elements of this PDO:

Bytes 0..1 WFI-OCT A-Scan 1 local maximum value (16 bits, type UINT)

Bytes 2..3 WFI-OCT A-Scan 2 local maximum value (16 bits, type UINT)

Bytes 4..5 WFI-OCT A-Scan 3 local maximum value (16 bits, type UINT)

...

Bytes 508..509 WFI-OCT A-Scan 255 local maximum value (16 bits, type UINT)

WFI-OCT A-Scan localmax data 2 PDO (0x1A11)

This PDO is only of use together with the WFI-OCT hardware. If the ASC does not have the WFI-OCT hardware, then please don't use this PDO.

This PDO contains local maximum values for further 129 WFI-OCT A--Scans, which occurred after the 255 WFI-OCT A-Scan values which can be found in TxPDO 0x1A10.

Elements of this PDO:

Bytes 0..1 WFI-OCT A-Scan 256 local maximum value (16 bits, type UINT)

Bytes 2..3 WFI-OCT A-Scan 257 local maximum value (16 bits, type UINT)

Bytes 4..5 WFI-OCT A-Scan 258 local maximum value (16 bits, type UINT) ...

Bytes 256..257 WFI-OCT A-Scan 384 local maximum value (16 bits, type UINT)

If you want to be sure to receive every WFI-OCT A-Scan local maximum value, then please make sure to configure the EtherCAT master cycle time to a value smaller than 4 ms.

Description of RxPDOs:

PLC control data PDO (0x1600)

This PDO contains 32 bits of PLC control data to control job execution on the ASC. At the moment, only Bits 1 and 3 are used:

Bit 0 reserved, not used

Bit 1 Job start

Bit 2 reserved, not used

Bit 3 Job abort

all other bits reserved, not used

See also section Optionally connecting a programmable logic controller in the ARGES system controller manual.

GPIO input data PDO (0x1601)

This PDO contains 32 bits of general purpose inputs which can be viewed in the ethercat device node properties, see chapter Viewing general purpose inputs below.

5. Set the EtherCAT master to OP state.

12.1.1.2 Configuration of the ethercat device

Requirements

1. The EtherCAT master device is correctly configured to exchange data with the ASC as a EtherCAT slave device.
2. The EtherCAT network is up and running in OP state.

Procedure

1. Create a new ethercat device and edit its configuration, see [1] chapter Managing Devices.
2. In Resource select the Interface the device shall be assigned to.

   If none is the only available interface in the list then click **Detect**.

   If an EtherCAT interface is detected then it will be listed in the Interface list. If no interface is detected then there will be no feedback on this result.
3. If you want to control job execution via EtherCAT (TxPDO 0x1A00 and RxPDO 0x1600) then in Settings, activate **PLC I/O controlled by EtherCAT**.
4. If you want to use GPIO outputs/inputs (TxPDO 0x1A01 and RxPDO 0x1601) then enable the checkbox GPIO data enable, otherwise disable it.
5. If you want to transmit WFI-OCT B-Scan summary data (TxPDO 0x1A02) then enable the checkbox WFI B-Scan summary data enable, otherwise disable it.
6. If you want to transmit WFI-OCT A-Scan data including WFI-OCT local maximum values and position/timestamp data (TxPDOs 0x1A03, 0x1A10 and 0x1A11) then enable the checkbox WFI A-Scan data enable, otherwise disable it.
7. If you want to use GPIO outputs (TxPDO 0x1A01), then set each output you want to use to Used in the group box GPIO output configuration. Set all others to Not used.

8. Activate the ethercat device, see [1] chapter Managing Devices. As soon as the device has been activated, it will start exchanging EtherCAT data with a connected EtherCAT master.
9. Make the device configuration permanent, see [1] chapter Managing Devices.

12.1.2 Usage

Viewing general purpose inputs

Procedure

- In the Node Properties window of the device, click the GPIO Inputs tab.

  In the group box General purpose inputs you can see the input value of each input in the field Value. You can define a signal name for each input in the field Signal name. Additionally, you can define a name for the logical 0 state and logical 1 state of each input in the fields State 0 name and State 1 name. These names will appear in the field Value name depending on the current state of the input.

Setting general purpose outputs

Procedure

- In the Node Properties window of the device, click the GPIO Outputs tab.

  In the group box General purpose outputs you can set the output value of each output in the field Value to either FALSE or TRUE. You can define a signal name for each output in the field Signal name. Additionally, you can define a name for the logical 0 state and logical 1 state of each output in the fields State 0 name and State 1 name. These names will appear in the field Value name depending on the current state of the output.

12.2 UserIo

The UserIo device is an ASC-internal device and can be used for writing to the outputs and reading from the inputs of the UserIo interface at the back of the ASC.

12.2.1 Requirements

- Your ASC has to be equipped with a UserIo interface.

12.2.2 Configuration

Configuring the output mapping

Procedure

1. Create a new UserIo device and edit its configuration, see [1] chapter Managing Devices.
2. In the group box Output configuration, configure for each of the 16 outputs if it is Used or Not used.
3. In the group box Output/Input supply group configuration, configure for each of the 4 input and output supply groups if it is used and thus if you want to select the output supply voltage or input voltage for the corresponding outputs and inputs or not. Set the groups to Used or Not used respectively. If you configure some outputs to Used, the corresponding output supply groups will be automatically set to Used during device activation.
4. Activate the UserIo device, see [1] chapter Managing Devices.
5. Optionally make the device configuration permanent, see [1] chapter Managing Devices.

12.2.3 Usage

12.2.3.1 Configuring the output group supply voltages

Procedure

1. In the UserIo Device's node properties, change to the tab Voltage.
2. In the group box Voltage settings outputs you can select for four different output groups if the outputs of these groups use the Internal 5V supply or if they use an External supply. The external supply voltage has to be connected to the correct pins on the UserIo interface. Please refer to the ASC manual.

12.2.3.2 Configuring the input group voltages

Procedure

1. In the UserIo Device's node properties, change to the tab Voltage.
2. In the group box Voltage settings inputs you can select for four different input groups if the inputs of these groups use 24V or 5V input levels.

12.2.3.3 Setting the output descriptions

Procedure

1. In the UserIo Device's node properties, change to the tab Outputs.
2. Under the column Signal name you can define a name for each output. Under the columns State 0 name and State 1 name you can define a name for each signal's low level and high level respectively.

12.2.3.4 Setting the outputs

Procedure

1. In the UserIo Device's node properties, change to the tab Outputs.

2. Under the column Value you can set each output to FALSE or TRUE. The setting FALSE sets the corresponding output to low level and the setting TRUE to high level respectively. The current state of the output is also shown under the column Value namewhere the user defined output level names under the columns State 0 name and State 1 name are used.

12.2.3.5 Setting the input descriptions

Procedure

1. In the UserIo Device’s node properties, change to the tab Inputs.
2. Under the column Signal name you can define a name for each input. Under the columns State 0 name and State 1 name you can define a name for each signal’s low level and high level respectively.

12.2.3.6 Viewing the input states

Procedure

1. In the UserIo Device’s node properties, change to the tab Inputs.
2. Under the column Value you can see the state of each input. The value FALSE corresponds to the input’s low level and the value TRUE to the input’s high level respectively. Additionally, you can also see the state of each input under the column Value name. The user defined signal names under the columns State 0 name and State 1 name are used there to display the input’s state.

12.3 PlcDiag

A PlcDiag device is a ARGES system controller-internal device. Its purpose is to display the states of the inputs and outputs of the electrical PLC and PLC AUX connectors.

12.3.1 Requirements

- Every ARGES system controller has a PLC and a PLC AUX connector, so there are no further requirements for using this device.

12.3.2 Configuration

Procedure

- Create a new PlcDiag device. There are no configuration values which can be adjusted, so the device can immediately be activated.

12.3.3 Usage

Viewing input and output states of the electrical PLC interface

Procedure

- In the Node Properties window of the device, click the Electrical PLC interface tab.

  For each input and output signal at the PLC and the PLC AUX connector, the current signal state is displayed in column Signal state.

  If the Signal state is `TRUE` then the signal at the respective pin has a high level and the ”LED” is lit green, if it is `FALSE` then the signal has low level and the ”LED” is off (gray).

  Additionally, the connector (PLC or PLC AUX) and the pin number of each input and output of the interface is displayed.

  Consult the ASC manual for a description of all available PLC input and output signals.

13 Devices: Motion Control

Stepper

PositionEncoder / On-The-Fly

AcsEcmsm

13.1 Stepper

The Stepper device drives a stepper motor with an optional position monitoring by an encoder.

13.1.1 Requirements

- You need hardware that is ARGES-approved and supported by this driver. Not every stepper motor application can be used with this driver.
- You need information about the stepper motor hardware that is in use and it's configuration within the system. See section Configuration for more information about that.

13.1.2 Configuration

TIP

In general the Stepper device is already pre-configured by ARGES.

- Do not change the configuration.

Procedure

1.

⚠ CAUTION

Wrong setting on the Sensors tab

can cause mechanical damage when the Stepper driver is activated.

2. Make sure that the settings on the Sensors tab conform to the hardware that is in use. Get the correct values for these settings from your hardware vendor.
3. For the Home sensor, Pass through sensor (optional) and End sensor set the correct Trigger edge that should be detected and the correct Pin where the respective sensor is connected to.

1. Create a new Stepper device and edit its configuration, see [1] chapter Managing Devices.
2. Configure the parameters necessary for your stepper device.

   In the following procedures also consider details from the stepper device's user manual.

13.1.2.1 Selecting the resource

Procedure

1. On the Resource tab, if Stepper device is empty then click **Detect**.
2. In Stepper device, select the interface for the stepper motor. This usually is DisStepper_0.
3. If your hardware supports an encoder, select the interface for the Encoder device. This usually is DistEncoder_0.

13.1.2.2 Configuring the axis

Procedure

1. On the Axis tab, select the Unit that you want to use for the axis.

The Unit depends on the mechanical construction of the system. You can choose between mm, steps or ° (degree).

2. Set the Stepper steps per unit according to the mechanical construction.

   This ensures that the movement is as expected.

3. If your system has an encoder then set its resolution in Encoder steps per unit.

4. Set Overtravel to ensure that every movement to a target position is done from one direction independently of the position that the axis had before. If you have an overtravel of e.g. -0.5 mm that a positioning command to a target position of 10 mm will first move to 9.5 mm and from that point to 10 mm. This avoids hysteresis due to mechanical tolerances.

5. Set Max. position corrections as the limit for the number of attempts to reach the target position within the specified tolerance. If the number of attempts exceeds this limit then an error is issued and the device goes into failure state.

6. Set the Allowed position deviation.

   This is used for 2 purposes. While the axis is moving the setting defines the tolerance of the target position and thus if the axis has to be moved any further. While the axis stands still the setting is used as an upper limit of the allowed deviation between the target and the actual position on the encoder in the case that the axis moves without an actual command to move, e.g. due to mechanical or thermal influence. If the comparison between the value where the axis was positioned to and the current value exceeds the setting then an error is issued and the device goes into failure state.

7. At every movement the divergence between the moved length on the stepper motor and the measured length on the encoder is checked:

   a) Set the Max. stepper to encoder divergence where an error shall be issued and the stepper device shall go into failure state.

   b) Set the Warn stepper to encoder divergence where just a warning message shall be sent.

8. Check Encoder reverse if the positive direction of the encoder is opposite to the positive direction of the stepper motor. In general, this setting has already been done by ARGES.
9. The Encoder origin and the Stepper origin define the zero point of the system. Both values have to be determined in a post-production procedure that has to be repeated every time the mechanical components change. In general this has already been done by ARGES. The original values can be found in the Test Report - Delivery.

13.1.2.3 Configuring the motor

For the following settings you need detailed information from the vendor of your system. In general the settings have already been done by ARGES.

Procedure

1. On the Motor tab, select the Motor type to determine the hardware setting that is used for driving the stepper motor.
2. In Current limit the current to a percentage of the maximum available current to drive the stepper motor for normal movement.
3. In Velocity set the velocity for the stepper motor's normal movement.
4. In Acceleration set the acceleration for the stepper motor's normal movement.
5. In Current for init run, Velocity for init run and Acceleration for init run set the respective values that are used during the initialization run i.e. when finding the end sensors.

13.1.2.4 Configuring the sensors

On the Sensors tab configure the stepper motor's sensors, named Home sensor, Pass through sensor (optional) and End sensor. When activating the device, the axis moves a few times to the home and end sensors to determine the stepper positions at these sensors and to initialize the encoder if one is present. The home sensor is the position where the stepper motor position is Zero.

13.1.3 Usage

13.1.3.1 Moving to a target position

Define target positions in the stepper pen sections of different pens, see also [1] chapter Working With Pens, and use these pens by placing organizing Use Pen nodes within the job tree structure in the Navigator view. The following 2 procedures show how to do this.

Defining target positions

Procedure

1. In the Navigator view, open the context menu of Pens.
2. Click **Create pen**.

   The Create New Pen window opens.
3. Enter a meaningful Pen name and click **OK**.

   In the Navigator view the Pens subtree expands.

   TIP

   If many target positions shall be defined then meaningful names help to identify the pens and target position respectively later on.
4. Open the context menu of the newly created pen.
5. Click **Create pen section**.

   The New Pen Section window opens.
6. In Type, select **stepper** and click **OK**.

   In the Navigator view a stepper pen section is added.
7. In the Node Properties view, set the Target position.

   Repeat these steps for as many target position as you need to move to within a job.

Using target positions within a job

Procedure

1. In the Navigator view, expand the job where you want to place the target position.
2. Add an organizing **Use pen** node to the job.
3. Drag and drop the node to its intended position within the job subtree.
4. In the Node Properties view, enter the Pen name and thus the target position you want to use.

   When a pen changes parameters, while executing a job, the Stepper device is set to busy until the target position is reached. This means that job execution is delayed until the axis reaches its target position. Then the job continues execution with the next job node in the job tree hierarchy.

13.1.3.2 Retrieving information for diagnostics

Find information for diagnostics in the Node Properties view of the active Stepper device.

Information on the Common tab

- Target position shows the target position as set with the pen mechanism described in section Moving to a target position.
- Relative position is only available if you configured the Stepper device without an encoder. In this case the stepper can only make relative movements because no encoder position is available to check the absolute position of the axis.
- Current position and Current encoder position show the actual position of the axis as measured from the stepper motor and the encoder respectively. These values can differ slightly from each other. The positioning is made by ensuring that the encoder position is within the configured limit of the target position.
- Stepper state shows the current state of the Stepper driver, such as idle, moving etc.

Information on the Advanced tab

- Position corrections shows how many single movements (corrections) were made to reach the target position within the configured deviation. This value updates with each movement.
- Current stepper position is the current position of the stepper in steps. This value updates during movement approximately every 200 ms.
- Current encoder position is the position of the encoder in steps when an encoder is present. This value updates during movement approximately every 200 ms. The values of Current encoder position and Current stepper position do not update synchronously.
- Stepper to encoder divergence shows the divergence between the movement length of the stepper and the encoder after each movement.
- Stepper home position and Stepper stop position show the position where the stepper motor hits the home and stop sensors in steps. The Stepper home position is usually 0 because after the initialization run the stepper reference is set to 0 where the home sensor is hit. Both values are set after the initialization run.
- Encoder home position shows the position in encoder counts where the home sensor is hit. This value is set after the initialization run. It is usually not 0 because the encoder zero position is at its optical index mark.
- Alarm status shows the current status of the encoder alarm output and is useful for diagnosis when the initialization run fails.
- In Move stepper relative you can move the stepper motor for diagnosis and setup. Don’t use this under normal conditions, because some safety mechanisms may be overwritten or the device may issue an error.

13.1.3.3 ”Hit a position switch error”

If the stepper is accidentally left in its home position switch you will get an ”-Hit a position switch error” after activating the device. When this error occurs do the following:

Procedure

1. Do a power cycle.

2. If the error persists then:

    a) In the Node Properties view of the active Stepper device on the Advanced tab, click **Move free (away from home)**.

       This temporarily disables the home position switch and moves the axis away from the home position for a few millimeters.

    b) Do a power cycle to ensure that the reference position is correct.

13.2 PositionEncoder / On-The-Fly

The position encoder device allows to configure position encoders connected to the POSITION ENCODER ports on the ARGES system controller.

At the moment, only 1 position encoder is supported.

13.2.1 Requirements

See the ARGES System Controller User Manual, section Optionally connecting position encoders.

13.2.2 Configuration

Please do not change any other settings than the ones described below.

Procedure

1. Create a new PositionEncoder device and edit its configuration, see [1] chapter Managing Devices.
2. In Resource, select the Device the driver shall be assigned to.

   If none is displayed then check the connection from the position encoder to the first POSITION ENCODER port at the ARGES system controller and click **Detect**.

   If a Position Encoder device is detected then it will be listed in the Device list. If no device is detected then there will be no feedback on this result.
3. In Encoder settings, select the encoder Direction either to **+** or **-**. This setting defines whether the signals are incremental or decremental. This actually depends on the machine setup.
4. Activate the PositionEncoder device, see [1] chapter Managing Devices.
5. Optionally make the device configuration permanent, see [1] chapter Managing Devices.

13.2.3 Usage

Please do not change any other settings than the ones described below.

Procedure - Setting the RPT cycle

1. Edit the positionencoder device settings, see [1] chapter Managing Devices.
2. Click the **Status** tab.
3. Set the **Rpt cycles**.

   The term Rpt means ”Revolutions per time”. This setting defines the number of FPGA clock cycles over which the number of changes in the position encoder counter value is counted for the frequency measurement. One FPGA clock cycle is 1/125000000 seconds or 8 ns long.

13.3 AcsEcmsm

The AcsEcmsm device opens up a connection to an AcsEcmsm XY-table device and makes it usable in InScript.

13.3.1 Requirements

- The controller of the AcsEcmsm table must be connected via its RS232 port to the ASC.
- Before the firmware is started, the table must be connected to the controller and running.

TIP

Do not connect the table to the RS232/CAN interface of the ASC. Use a RS232/USB converter instead and connect it to one of the USB ports of the ASC.

13.3.2 Configuration

Configuring the AcsEcmsm resource and baudrate

Requirements

The AcsEcmsm must be connected to the Controller and running, before the firmware is started.

Procedure

1. Create a new AcsEcmsm device and edit its configuration, see [1] chapter Managing Devices.
2. In the group box Resource select the communication port where the axis controller is connected. With the RS232/USB converter, this port is named UART USBx with x being a number depending on the connected converter.
3. In the group box Settings set the baudrate to the value that is configured in the axis controller. The preferred value is 115200 baud.
4. Activate the AcsEcmsm device, see [1] chapter Managing Devices.

5. Optionally, make the device configuration permanent, see [1] chapter Managing Devices.

Performing the homing sequence

The homing sequence adjust the AcsEcmsm device for usage.

CAUTION

Before the AcsEcmsm device will accept values for the axis, the

homing sequence must be done!

Procedure

1. Press the Do homing button In the Homing sequence group of the AcsEcmsm device.
2. After the button is pressed the status under the button In the Homing sequence group of the AcsEcmsm device will change from Homing not done to Homing in progress.
3. After some time the status under the button In the Homing sequence group of the AcsEcmsm device change from Homing in progress to Homing is done to show that the sequence is done.

13.3.3 Usage

Setting the position value

The position values define the position the device will move to.

Procedure

1. Edit the AcsEcmsm pen-section settings, see [1] chapter Working with Pens.
2. In the Table Position group, in the field X Position, enter the desired position x-value.
3. In the Table Position group, in the field Y Position, enter the desired position y-value.
4. In the Table Velocity/em> group, in the field Velocity, enter the desired

velocity between 10 and 300.

Setting the table velocity

This value defines the velocity the table will use.

Procedure

1. Edit the AcsEcmsm pen-section settings, see [1] chapter Working with Pens.
2. In the Table Velocity group, in the field Velocity, enter the desired value.

14 Devices: Miscellaneous

A400Tec

Shutter

VisIllum

SpdV21

McbCtr

Flash

SFT

SysMon

OnTheFly / Always-On On-The-Fly (AO-OTF)

14.1 A400Tec

14.1.1 Explanation of common alarms

This chapter explains some common alarms which can be seen on the ”Alarm” tab in the A400Tec device node properties.

1. FillLevelInt: The fill level on the internal loop is invalid.
2. FillLevelIntLower: The fill level on the internal loop is too low.
3. FillLevelExt: The fill level on the external loop is invalid.
4. FillLevelExtLower: The fill level on the external loop is too low.
5. Pump Internal 1: Revolution speed error on pump 1 on the internal loop.
6. Pump Internal 2: Revolution speed error on pump 2 on the internal loop.
7. Pump External 1: Revolution speed error on pump 1 on the external

loop.

8. Pump External 2: Revolution speed error on pump 2 on the external loop.
9. Pump External 3: Revolution speed error on pump 3 on the external loop.

14.2 Shutter

The Shutter device drives ARGES shutter hardware. A shutter is built into some scan head models.

14.2.1 Configuration

Procedure

1. Create a new Shutter device and edit its configuration, see [1] chapter Managing Devices.
2. In Resource, select the Device the driver shall be assigned to.

   If none is displayed or your shutter is not listed then click **Detect**.

   If a device is detected then it will be listed in the Device list. If no device is detected then there will be no feedback on this result.
3. The shutter can communicate its state to a receiver device.

   In Message Out Port ”State”, optionally select the Receiver device name.

   If none is displayed or your receiver device is not listed then click **Detect receiver**.

   If a receiver device is detected then it will be listed in the Receiver device name list. If no receiver device is detected then there will be no feedback on this result.
4. If you want to record messages to an ASC system controller internal log-file then activate **Trace messages**.
5. Activate the device, see [1] chapter Managing Devices.
6. Make the device configuration permanent, see [1] chapter Managing Devices.

14.2.2 Usage

14.2.2.1 Opening and closing the shutter

Procedure

1. Edit the Shutter device settings, see [1] chapter Managing Devices.
2. In the Target state list, select the corresponding entry.

   Current state shows the shutters state and the shutter makes a clicking sound.

14.2.2.2 Testing the shutter

Procedure

1. Edit the Shutter device settings, see [1] chapter Managing Devices.
2. Click **Request selftest**.

   The test opens and closes the shutter with a clicking sound and takes 5 seconds at least. If the test fails then an error will be shown in the Messages View.

14.3 VisIllum

The VisIllum device drives a Vertical Cavity Surface Emitting Laser (VCSEL) which illuminates the working area collinear through the processing optics in some scan head models.

14.3.1 Configuration

Procedure

1. If you are using a HSSI scanhead, make sure that its power supply is switched on before the ASC is switched on, as the VisIllum hardware for HSSI scanheads does not support hotplugging.
2. Create a new VisIllum device and edit its configuration, see [1] chapter Managing Devices.
3. In Resource select the Device the driver shall be assigned to.

   If none is displayed or your VisIllum is not listed then click **Detect**.

   If a device is detected then it will be listed in the Device list. If no device is detected then there will be no feedback on this result.
4. Activate the device, see [1] chapter Managing Devices.

   After the VisIllum device has been activated the illumination is off by default.
5. Make the device configuration permanent, see [1] chapter Managing Devices.
6. Note that the VisIllum device will switch to state ”not ready” when the hardware is not available. It will automatically switch to ”ready” as soon as the hadware becomes available (again).

14.3.2 Usage

The laser diode of the VisIllum device is switched with a constant frequency of 768 kHz.

The VisIllum device is a class 3B laser product according to DIN EN 60825-1-:2008-05.

Wavelength = 850 nm; max. mean power = 100 mW

Procedure

1. Edit the VisIllum device settings, see [1] chapter Managing Devices.
2. **CAUTION**

   Invisible laser radiation

   Damage to eye or skin

   a) Avoid eye or skin exposure to direct or scattered radiation.

   b) Set the intensity by the variables Channel 1, Channel 2 and Duty cycle.
   Channel 1 corresponds to 1/3 and Channel 2 corresponds to 2/3 of full intensity. The Duty cycle applies to both channels. Full intensity can be reached by enabling both channels and setting the Duty cycle to 100 %.

14.4 SpdV21

A SPD-device is a ASC system controller internal device, and is responsible for power distribution for internal and external connections.

14.4.1 Requirements

- Your ASC system controller has to be equipped with a SPD, V21.

14.4.2 Configuration

Procedure

1. Create a new SpdV21 device and edit its configuration, see [1] chapter Managing Devices.
2. In Resource, select the HDMI SPD the driver shall be assigned to.

   If none is displayed then click **Detect**.

   If a SpdV21 device is detected then it will be listed in the HDMI SPD list. If no device is detected then there will be no feedback on this result.
3. Activate the SpdV21 device, see [1] chapter Managing Devices.
4. Make the device configuration permanent, see [1] chapter Managing Devices.
5. Continue the configuration as described in the following section including its subsections.

14.4.3 Usage

Any SpdV21 device distributes power to 3 so called power slots. Each slot has a supply at its input, some kind of switching logic in between and several power outputs.

14.4.3.1 Viewing the housekeeping slot states

The power distribution in the Housekeeping slot is internal to the ARGES system controller and done automatically. Nevertheless you can view the states of this slot.

Procedure

1. Edit the spdv21 device settings, see [1] chapter Managing Devices.
2. Click the **Housekeeping** tab.

   The Housekeeping slot supplies all components internal to the ARGES system controller, such as:

   Slot power is the power input to this slot

   ASC supply is for the ASC board and associated boards, the heart of the ARGES system controller

   SFT supply is for the SFT (safety) board of the system, if present

   HDHI supply is for a number of minor components including the display(s)

14.4.3.2 Setting the scan heads slots

The Scan heads slot distributes power to both SCAN HEAD POWER outputs at the ARGES system controller.

Procedure

1. Edit the spdv21 device settings, see [1] chapter Managing Devices.
2. Click the **Scan heads** tab.
3. If you want to power 1 or 2 scan heads then, in group Slot power, set Slot power set to **enabled** and select the Slot voltage set to a voltage of either **+40VDC** or **+48VDC** according to the scan head model you want to power.

   This has to be done only once. From then on the selected voltage will be restored on each power cycle.

   Slot power primary and Slot power secondary show the the respective state. The two slots cannot be controlled separately in the current implementation.

4. Make the device configuration permanent, see [1] chapter Managing Devices.

By default the configuration for this slot defines all inputs and outputs as disabled.

14.4.3.3 Setting other misc. slots

The Misc slot slot mainly distributes power to laser devices integrated in the ARGES system controller, if present.

Procedure

1. Edit the spdv21 device settings, see [1] chapter Managing Devices.
2. Click the **Misc slot** tab.
3. If you want to power this slot then, in group Slot power, set Slot power set to **enabled**.

   Slot power show the state.
4. If you want to power the respective output then, in groups Aux out, Laser1 out, Laser2 out and Laser housekeeping out set the respective Supply set to **enabled**.

   Supply actual shows the respective state.
5. If you want to include Aux out, Laser1 out, Laser2 out and Laser housekeeping out in the safety concept then set the respective Safe mask set to **enabled**.

   If Safe mask set is enabled then the respective power output will be powered down immediately regardless of any user action in case of an emergency halt.

   Safe mask actual shows the respective state.
6. Make the device configuration permanent, see [1] chapter Managing Devices.

By default the settings on the Misc slot tab are as follows:

Slot power set disabled

Aux out supply set disabled

Aux out safe mask set disabled

Laser 1 supply set disabled

Laser 1 safe mask set enabled

Laser 2 supply set disabled

Laser 2 safe mask set enabled

Laser housekeeping out supply set enabled

Laser housekeeping out safe mask set disabled

14.4.3.4 Viewing information useful for troubleshooting

Procedure

1. Edit the spdv21 device settings, see [1] chapter Managing Devices.
2. Click the **Info** tab.

   This tab shows some information about versions and switch states:

   FPGA revision is the version of SPD's logic block

   DIP switch 1001 and DIP switch 1002 are the states of certain switch banks on the SPD board. As a lot of the SpdV21 device's configuration options are depending on these switches, information about their state is useful for troubleshooting

   Shutdown by SFT is a flag that indicates that the SPD board is directly connected to a SFT board in terms of emergency shutdown

14.4.3.5 Setting the device states

Procedure

1. Edit the spdv21 device settings, see [1] chapter Managing Devices.
2. On the Device states tab, set the Lowest state you want to allow. The power state machine states ready, standby, down and off are mapped

as follows:

ready SpdV21 is fully operable.

standby SpdV21 is in safe-state.

down SpdV21 is not operable.

off SpdV21 is not operable.

3. Set the Ready to standby timeout, Standby to down timeout and Down to off timeout for state transitions.
4. Make the device configuration permanent, see [1] chapter Managing Devices.

14.5 McbCtr

The McbCtr device is an ARGES system controller-internal device, and is responsible for power distribution to internal and external connections.

Any McbCtr device is a power distributor with a sum of multiple so called power-slots. Each slot has a supply at its input, some kind of switching logic in between and several power-outputs.

14.5.1 Requirements

- The ARGES system controller has to be equipped with a MCB600CTR board. Normally this is only the case for ASC-1 controllers.

14.5.2 Configuration

Configuring the McbCtr resource

Procedure

1. Create a new McbCtr device and edit its configuration, see [1] chapter Managing Devices.
2. In Resource, select the HDMI MCB600CTR the driver shall be assigned to.

   If none is displayed then click **Detect**.

   If a MCB600CTR device is detected then it will be listed in the HDMI MCB600CTR list. If no device is detected then there will be no feedback on this result.
3. Activate the McbCtr device, see [1] chapter Managing Devices.
4. Optionally make the device configuration permanent, see [1] chapter Managing Devices.

14.5.3 Usage

14.5.3.1 Viewing information about power-slots

The Housekeeping slot of device McbCtr supplies all system controller internal components, such as Asc supply that supplies the ASC board, the heart of the system controller, and the Hdhi supply that supplies a number of minor components including the system controller's own display(s)

Power distribution in the Housekeeping slot is performed standalone without the need for an user to interact.

Procedure

1. Edit the mcbctr device settings, see [1] chapter Managing Devices.
2. Click the **Housekeeping** tab.

14.5.3.2 Viewing information about scan heads slots

The Scan heads slot of device McbCtr powers both outputs of the system-controller to the scan heads.

Procedure

1. Edit the mcbctr device settings, see [1] chapter Managing Devices.
2. Click the **Scan heads** tab.
3. In Scanhead power set, set the power input to both scan head slots to **enabled** or **disabled**.

   Scanhead power status shows the actual state.

   Both scan head slots output +48 V DC. Note that the power will only be switched on if a scan head is connected to the output slot.

   The default configuration of this slot defines both scan head outputs as off.
4. Make settings exposed to changes permanent, see [1] chapter Managing Devices.

14.5.3.3 Procedure for viewing information about the Misc slot

The Misc slot of device McbCtr is used to power various devices connected to the ASC.

Procedure

1. Edit the mcbctr device settings, see [1] chapter Managing Devices.
2. Click the **Misc.** tab.
3. In Supply set, set misc. slot to **enable** or **disable**.

   Supply actual shows the actual state.

   The Misc slot outputs +24 V DC when switched on.
4. Make settings exposed to changes permanent, see [1] chapter Managing Devices.

14.5.3.4 Viewing internal device information

The Info tab presents some information about versions and switch-states of the McbCtr device.

Procedure

1. Edit the mcbctr device settings, see [1] chapter Managing Devices.
2. Click the **Info** tab.

   Fpga revision is the version of McbCtr's logic block.

   Dip switch 1000 is the state of a certain switch bank on the MCB600-CTR-board. As a McbCtr knows a lot of configuration options depending on these switches, information of the state may be useful when targeting a problem.

   Shutdown by HDHI is a flag indicating that the McbCtr-board is directly connected to HDHI-board in terms of emergency-shutdown.

14.5.3.5 Setting device states

Procedure

1. On the Device states tab, set the Lowest state you want to allow, where the power state machine states ready, standby, down and off are mapped as follows:

   ready indicates that the McbCtr is fully operable.

   standby indicates that the McbCtr is in safe-state.

   down indicates that the McbCtr is not operable.

   off indicates that the McbCtr is not operable.

2. On the Device states tab, set the Ready to standby timeout, Standby to down timeout and Down to off timeout for state transitions.

3. Make the device configuration permanent, see [1] chapter Managing Devices.

14.6 Flash

The flash device manages the ARGES system controller's memory. The ARGES system controller's configuration is saved in a file that is called `flash.xml`.

14.6.1 Configuration

The flash device cannot be deactivated as it is essential for the ARGES system controller's operation. Thus the flash device cannot be configured like other devices.

14.6.2 Usage

The flash device has no graphical user interface.

CAUTION

Editing variables via the Inspector

can result in loss of data.

- **Do not** edit variables in the flash device via the Inspector.

- To download or upload the configuration file `flash.xml` use the Webservices:

  In the Navigator window in the respective ARGES system controller's context menu, click **Webservices**.

14.7 SFT

If a SFT board is present in the ARGES system controller then the SFT board monitors safety related chains and switches off safety relevant devices when a safety event occurs, e.g. when the emergency switch is being pressed. Please consult the ARGES system controller manual for more information on the wiring of the SFT device.

14.7.1 Configuration

Requirements

- All safety related chains have to be correctly wired to the SFT board.

Procedure

1. Create a new Sft device and edit its configuration, see [1] chapter Managing Devices.
2. In Resource, select the Device the driver shall be assigned to.

   If none is displayed then click **Detect**.

   If an Sft device is detected then it will be listed in the Device list. If no device is detected then there will be no feedback on this result.
3. Activate the sft device, see [1] chapter Managing Devices.
4. Make the device configuration permanent, see [1] chapter Managing Devices.

14.7.2 Usage

14.7.2.1 Enabling the SFT watchdog

If the SFT watchdog is enabled then the InScript firmware has to continually trigger it or else the SFT will switch to emergency status and switch off all connected safety related devices. The maximum allowed time between 2 triggers is called the Watchdog timeout and can be selected by the user.

Procedure

1. In the InScript software in the Navigator window, open the **sft** device.
2. On the Watchdog tab, select the desired watchdog **Timeout**.

   The value can be in the range from 0 to 1400 ms. At a value of 0 ms the watchdog will trigger immediately.
3. Select Enable.

14.7.2.2 Disabling the SFT watchdog

Procedure

1. In the InScript software in the Navigator window, open the **sft** device.
2. On the Watchdog tab, deselect **Enable**.

14.7.2.3 Viewing the interlock stati

Procedure

1. In the InScript software in the Navigator window, open the **sft** device.
2. Click the **Interlocks** tab.

   For each interlock from A to C it is shown whether the connected interlock chain is open or closed.

14.7.2.4 Viewing the FPGA Revision

Procedure

1. In the InScript software in the Navigator window, open the **sft** device.
2. Click the **Common** tab.

   The FPGA Revision is shown.

14.7.2.5 Resetting the SFT

This only works for SFT board of versions before version 2.0.

Procedure

1. In the InScript software in the Navigator window, open the **sft** device.
2. Click the **Common** tab.
3. Activate **SFT self reset**.

14.7.2.6 Viewing the emergency shutdown status and clearing the emergency shutdown

Procedure

1. In the InScript software in the Navigator window, open the **sft** device.
2. Click the **Supervision** tab.

   Emergency shutdown shows the current emergency shutdown status. This may be inhibit, pending or unknown.
3. To clear a emergency shutdown, change Clear emergency shutdown from passive to **clear**.

   Then the emergency shutdown will be cleared and Clear emergency shutdown will automatically change back to passive.

14.7.2.7 Viewing the safe request status

Procedure

1. In the InScript software in the Navigator window, open the **sft** device.
2. Click the **Supervision** tab.

   Safe request shows the current safe request status. This may be inhibit, pending or unknown.

14.8 SysMon

The sysmon device monitors the ARGES system controller for critical errors, e.g. if an over-temperature error occurs then the sysmon device initiates a hard shutdown. If the sysmon device's state is set to managed and a critical error occurs then an already running job will be aborted. As long as the error persists new jobs cannot be started then.

The sysmon device can neither be deactivated nor has it a graphical user interface.

14.9 OnTheFly / Always-On On-The-Fly (AO-OTF)

In an On-the-Fly system configuration of a laser scanning system the workpiece can move relative to the scan head during the laser process. The relative position and movement between the workpiece and the scan head is measured in real time by a position encoder and a signal representing that movement is provided to the controller. Using the movement input signal the controller calculates the necessary laser scanning position as seen from the scan head to follow the trajectory on the workpiece defined in the job.

14.9.1 Segmented and continuous processing

When the system is configured for On-the-Fly operation, the extent of the job geometry is usually larger than the scan field immediately accessible to the scan head. This means that at any point in time the system can only process parts of the job geometry that are inside the field accessible to the scan head.

There are different ways to ensure that this is the case, two of which will be described here.

14.9.1.1 Segmented processing

In segmented mode the time it takes to process one segment is more or less constant, with only a slight variance caused by a dependency on the length of the jump from the previous segment. When the relative velocity of the workpiece increases, there is a point where the time it takes to process a segment becomes longer than the time it takes the workpiece to travel a distance equivalent to the axial extent of the segment (the axial extent of the segment is the difference between the end position and the start position of the segment, measured only along the direction the workpiece is traveling). When that happens, the scan head can not keep up with the workpiece velocity any more and the job will be aborted with an error message. This means that the segmented OTF mode can only be used when the workpiece velocity is lower than a certain threshold.

Advantages:	**Disadvantages:**
Constant path velocity on the workpiece	Non-optimal laser utilization
Laser power and laser pulse timing don't need to be changed during the process	Longer overall process time due to necessary scanner jumps between segments
	Laser process discontinuities can cause undesireable effects on the workpiece

Table 14.1: Segmented processing

14.9.1.2 Continuous processing

In continuous mode there aren't any jumps between segments, and the laser is always on. In this mode the laser power and laser pulse frequency are reduced when the relative workpiece velocity is slow, this is done so that in e.g. cutting applications the laser power is high enough to cut through the workpiece, but not higher than necessary to avoid oxidizing the workpiece surface or bringing an unnecessarily high amount of heat into the workpiece. The laser power can only be reduced up to a certain point, though. Below that point the laser just can't cut through the workpiece any more. This means that the continuous OTF mode can only be used when the workpiece velocity is greater than a certain threshold.

Advantages:	**Disadvantages:**
No laser process discontinuities	Laser power lookup table calibration necessary
Optimal laser utilization	
Optimal process speed	

Table 14.2: Continuous processing

14.9.1.3 Automatic switching between segmented and continuous processing

The Always-on On-the-Fly mechanism in the ASC controller switches automatically between segmented and continuous mode when the workpiece velocity exceeds an upper threshold or falls below a lower threshold. The variables to define these thresholds are:

ThresholdSwitchCont The system switches to ’continuous’ AO-OTF operation when the workpiece velocity becomes higher than this threshold

ThresholdSwitchSegm The system switches to ’segmented’ OTF operation when the workpiece velocity becomes lower than this threshold

Due to the way the start of laser scanning in segmented OTF mode is synchronized with the workpiece movement, the axial workpiece position at which laser scanning will start must not have been reached yet when the system is ready to start laser scanning a segment. In segmented OTF mode this is achieved by placing all segments at the same axial position in the scan field. To satisfy this requirement at the moment the system switches from continuous mode to segmented mode it is necessary to add an axial position bias or offset to the average axial position in the scan field, to make sure that the time at which the continuous segment ends is earlier than the time the next ’segmented’ segment starts.

This axial bias is specified int the variable

ScanActivityPosOffset Axial position bias for the average scanner position in the scan field during ’continuous’ AO-OTF operation, needed to be able to switch back to ’segmented’ OTF operation”)

14.9.1.4 Buffering

The On-the-Fly mechanisms in the ASC controller require a certain amount of buffered data for their normal operation. This buffering causes a delay between the time the workpiece velocity crosses one of the two velocity thresholds and the time the switch from segmented to continuous mode or vice versa occurs. Depending on the geometry of the job it may be possible to reduce the buffering time to reduce the aforementioned delay, but it is recommended to keep the default value for the buffering time, which is specified in the variable

BufferingTime How much data can be buffered [s] (latency vs underrun)

14.9.1.5 Segment size limit

The job is specified in segments, and each of these segments should have an axial extent of no more than a certain percentage of the scan field size. The software checks whether all segments satisfy this requirement and issues an error message if a segment's axial extent is too large. The allowed percentage is specified in the variable

MaxSegmentSizePc The maximum axial segment length as a percentage of the field size.

14.9.2 "On the Fly" device driver configuration

DacLutSwitching Real time switching between DAC LUTs or DAC LUT pairs

- **Enable** Enable real time DAC LUT switching
- **UserIoInput** User I/O input to control DAC LUT switching
- **UserIoInputPolarity** User I/O input polarity
- **OnDelayDistance** Delay between user I/O rising edge and LUT switching
- **OffDelayDistance** Delay between user I/O falling edge and LUT switching
- **LutIndexA** DAC LUT or LUT pair A for switching
- **LutIndexB** DAC LUT or LUT pair B for switching

Pemg0 Position Encoder Matrix Generator 0 configuration

- **PemgIndex** PEMG instance configuration
- **EncPosRefinement** Position encoder dynamic range
- **EncFreqMeasurementUpdRate** Position encoder frequency measaurement interval

EncExtrapolationFactor Position encoder extrapolation coefficient

TransformationType PEMG transformation matrix type

LinearTransformation PEMG linear transformation configuration

- **VectorSpecType** Workpiece movement direction specification method
- **EncoderStepSize** Position encoder increment size
- **AngleAzimuthXY** Workpiece movement direction polar azimuth angle in the X/Y plane
- **AngleElevationZ** Workpiece movement direction polar elevation angle out of the X/Y plane
- **VectorX** Workpiece movement direction cartesian vector X component
- **VectorY** Workpiece movement direction cartesian vector Y component
- **VectorZ** Workpiece movement direction cartesian vector Z component
- **EncoderStepDirVectX** Workpiece movement per position encoder increment in scan field X direction
- **EncoderStepDirVectY** Workpiece movement per position encoder increment in scan field Y direction
- **EncoderStepDirVectZ** Workpiece movement per position encoder increment in scan field Z direction

ExtrapolationSpecType Position encoder extrapolation time unit

ExtrapolationTime Position encoder extrapolation time value

3dCtShiftX 3D coordinate transformation dynamic range X exponent

3dCtShiftY 3D coordinate transformation dynamic range Y exponent

3dCtShiftZ 3D coordinate transformation dynamic range Z exponent

SmPssId Synchronization message ID for ’Process Segment Start’

SmPssMask Synchronization message mask for ’Process Segment Start’

Pemg1 to Pemg7 Reserved for future use

PipeMuxConfig Enable/disable real time transformations

SmSpnId Synchronization message ID for 'Set PEMG Neutral'

SmSpnMask Synchronization message mask for 'Set PEMG Neutral'

DacLutSwitching Real time switching between DAC LUTs or DAC LUT pairs

- **Enable** Enable real time DAC LUT switching
- **UserIoInput** User I/O input to control DAC LUT switching
- **UserIoInputPolarity** User I/O input polarity
- **OnDelayDistance** Delay between user I/O rising edge and LUT switching
- **OffDelayDistance** Delay between user I/O falling edge and LUT switching
- **LutIndexA** DAC LUT or LUT pair A for switching
- **LutIndexB** DAC LUT or LUT pair B for switching

14.9.3 "On the Fly" device driver run time variables

Aootf ThresholdSwitchCont The system switches to 'continuous' AO-OTF operation when the workpiece velocity becomes higher than this threshold

- **ThresholdSwitchSegm** The system switches to 'segmented' OTF operation when the workpiece velocity becomes lower than this threshold
- **ScanActivityPosOffset** Axial position bias for the average scanner position in the scan field during 'continuous' AO-OTF operation, needed to be able to switch back to 'segmented' OTF operation
- **BufferingTime** How much data can be buffered [s] (latency vs underrun)
- **OverflowResetThreshold** Overflow reset threshold (do not change)
- **OverflowResetDelta** Overflow reset delta (do not change)

MaxSegmentSizePc The maximum allowed axial segment length as a percentage of the scan field size [%]

14.9.4 Requirements

See section PositionEncoder / On-The-Fly in this manual and see the ARGES System Controller User Manual, section Optionally connecting position encoders.

14.9.5 GUI

This section describes the GUI for Always-On On-The-Fly operation.

DAC LUT

The DAC LUT are lookup tables for the controller to determine which real laser power has to be output at different VFC speeds and laser power settings in the pens used in the job.

Note that currently from the 4 DAC LUTs only the first 2 are used. Table 0 is used for a CW laser and Table 1 is used for a pulsed laser. Further usage is in development.

Legend to figure 14.1 on page 224:

1. Table view of the DAC LUT values; see section Table view and graphs below.
2. Graphical representation of the DAC LUT values at the selected speed; see section Table view and graphs below.
3. Graphical representation of the DAC LUT values at the selected power; see section Table view and graphs below.
4. Edit field to change the name of the current table; see section Table names.
5. Change the size of the editable matrix and hide/show the non-editable fields; see section Editable matrix.
6. Load a saved DAC LUT table from a file; see section Loading table values from a file.

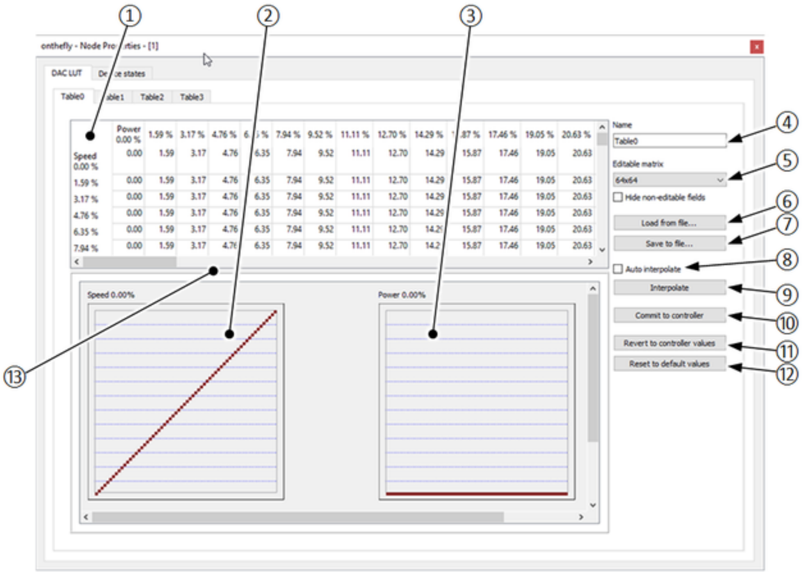


Figure 14.1: DAC LUT Editor

7. Save the current DAC LUT table to a file; see section Saving table values to a file.
8. Enable or disable the automatic interpolation; see section Automatic interpolation.
9. Perform a manual interpolation; see section Manual interpolation.
10. Commit the current DAC LUT table to the controller; see section Committing the DAC LUT to the controller.
11. Revert the current DAC LUT table to the values currently on the controller; see section Reverting DAC LUT to the values stored on the controller.
12. Reset the current DAC LUT table to default; see section Resetting the DAC LUT to default values.
13. Splitter to increase or decrease the size of table view or graphs view.

Table view and graphs below

The values in the table represent a 64x64 matrix of percentage values (0 to 100 %). Each row represents a set of power percentage values to configure the real output power at a given speed.

The speed is not the speed of the conveyor belt, it is the average axial path speed. 100 % in the DAC LUT table are reached, when the speed of the work piece equals the average axial path speed.

TIP

The average axial path speed can be calculated with the following formula:

Line speed ∗ Length of all segments / complete path length

This means, that the speed is not proportional to the speed of the conveyor belt.

NOTICE

The default values are set so that the laser power is always 100 %

of the optical power percentage that is set in the pen.

- In the pen, make sure that the power is set to the desired percentage.

When selecting a value the graph view below the table shows the values of row and column of the selected value. The left graph represents the values of the currently selected row, the right graph represents the values of the currently selected column.

14.9.6 Configuration

This section describes necessary configuration steps to prepare the system for Always-On On-The-Fly operation.

Procedure

1. In the Navigator view, double-click the controller you want to configure.

   This partially expands its tree structure.

Configure the laser device

2. In the Navigator view, expand Devices and click <**your laser**>.
3. If the device is Active, then deactivate it by opening the context menu (right-click) and clicking **Deactivate**.
4. In the Node Properties view on the Power tab, select the DAC channel for laser power control.
5. In Min. power at and Max. power at, set **0V** and **10V** respectively, even if your laser has a different input voltage range.
6. In the Navigator view, open the context menu of <your laser> and click **Activate** then.
7. In the Navigator view, expand **Pens** → **default (systempen)** and click <**your laser**>.
8. On the Control tab, set Power to **0 %**.
9. In the Navigator view, open the context menu of <your laser> and click **Deactivate** then.
10. In the Node Properties view on the Osc tab in the Internal gated group, set Config to **GatedOsc**.
11. In the Internal gated group in Signal, select one of the high-speed outputs (HSO0 to HSO7) that is used for the gate signal.
12. In the Navigator view, open the context menu of <your laser> and click **Activate** then.
13. In the Node Properties view on the Osc tab, set the laser pulse **Frequency** and **On-time** (pulse duration) to values that are appropriate for normal (segmented) On-The-Fly operation.

Configure the OnTheFly device

14. If you want to use a user io input to switch between two DAC LUT tables (by default tables 0 and 1) then deactivate the OnTheFly device. Click on the General tab. In the group box DAC LUT Switching set the checkbox Enable DAC LUT Switching. Select the desired User io input. Also select the desired Polarity. A value of High means that the DAC LUT table will be switched to table 1 when a rising edge occurs on the user io input and

will be switched back to table 0 when a falling edge occurs. A polarity value of Low means that the system will switch to table 1 when a falling edge occurs on the user io input and will switch back to table 0 when a rising edge occurs. Select the On delay and Off delay values in mm distance. The On delay value will be used to delay the switching of the LUT table after a leading edge on the user io input was detected, the Off delay value will be used to delay the switching of the LUT table after a trailing edge was detected. Activate the OnTheFly device again when the DAC LUT switching configuration is complete. The input level of the user io input (5V or 24V) can be defined in the user io device, please see the documentation there.

15. Determine the laser power control voltage input range for your laser.

    In the DAC lookup table, a value of 100 % gives an output voltage of 10 V. If your laser has a control voltage input range of 0 V to 5 V, the values in the DAC lookup table must not be greater than 50 %. If your laser has a control voltage input range of 0 V to 10 V, the values in the DAC lookup table can go up to 100 %.

Determine speed percentage values for laser power

16. In the Navigator view, expand Devices and click **onthefly**.
17. In the Node Properties view on the DAC LUT tab, click **Reset to default values** and confirm.

    Note, that the values are not automatically committed to the controller and that committing them to the controller overwrites the values stored on the controller.

18. Click **Commit to controller**.
19. Set Editable matrix to **5x5**.
20. Activate **Hide non-editable fields**.
21. Make a note of the Speed percentages on the leftmost column of the table.

    These are e.g., 0.00, 25.40, 50.79, 76.19, and 100.00 %.

Determine laser power control voltage for 100 % line speed

22. In the Navigator view, expand **Pens** → **default (systempen)**.
23. Click **linepar**.
24. In the Node Properties view on the Common tab, set the **Processing speed** to 100 % of the speed needed for normal (segmented) On-The--Fly operation e.g., 6000 mm/s.
25. In the Navigator view, click <**your laser**>.
26. In the Node Properties view on the Osc tab, set the laser pulse **Frequency** and **On-time** (pulse duration) to values that are appropriate for normal (segmented) On-The-Fly operation at e.g., 6000 mm/s.
27. Find the correct laser power control voltage for this speed e.g., 4.2 V.
28. Write the values down e.g., 4.2 V at 100 % of 6000 mm/s.

Determine laser power control voltage for 76.19 % line speed.

29. In the Navigator view, expand **Pens** → **default (systempen)**.
30. Click **linepar**.
31. In the Node Properties view on the Common tab, set the **Processing speed** to e.g., 76.19 % of the speed needed for normal (segmented) On-The-Fly operation e.g., 76.19 % of 6000 mm/s = 4571.4 mm/s.
32. In the Navigator view, click <**your laser**>.
33. In the Node Properties view on the Osc tab, set the laser pulse **Frequency** to e.g., 76.19 % of the value used in step 20 at 100 % speed.
34. Set the **On-time** (pulse duration) to e.g., 1 / 76.19 % = 131.25 % of the value used in step 20 at 100 % speed.
35. Find the correct laser power control voltage for this speed e.g., 3.5 V.
36. Write the values down e.g., 3.5 V at 76.19 % of 6000 mm/s.

Determine laser power control voltage for 50.79 % line speed

37. In the Navigator view, expand **Pens** → **default (systempen)**.

38. Click **linepar**.
39. In the Node Properties view on the Common tab, set the **Processing speed** to e.g., 50.79 % of the speed needed for normal (segmented) On-The-Fly operation e.g., 50.79 % of 6000 mm/s = 3047.4 mm/s.
40. In the Navigator view, click <**your laser**>.
41. In the Node Properties view on the Osc tab, set the laser pulse **Frequency** to e.g., 50.79 % of the value used in step 20 at 100 % speed.
42. Set the **On-time** (pulse duration) to e.g., 1 / 50.79 % = 196.89 % of the value used in step 20 at 100 % speed.
43. Find the correct laser power control voltage for this speed e.g., 3.2 V.
44. Write the values down e.g., 3.2 V at 50.79 % of 6000 mm/s.

Determine laser power control voltage for 25.40 % line speed

45. In the Navigator view, expand **Pens** → **default (systempen)**.
46. Click **linepar**.
47. In the Node Properties view on the Common tab, set the **Processing speed** to e.g., 25.40 % of the speed needed for normal (segmented) On-The-Fly operation e.g., 25.40 % of 6000 mm/s = 1525.0 mm/s.
48. In the Navigator view, click <**your laser**>.
49. In the Node Properties view on the Osc tab, set the laser pulse **Frequency** to e.g., 25.40 % of the value used in step 20 at 100 % speed.
50. Set the **On-time** (pulse duration) to e.g., 1 / 25.40 % = 393.70 % of the value used in step 20 at 100 % speed.
51. Find the correct laser power control voltage for this speed e.g., 3.0 V.
52. Write the values down e.g., 3.0 V at 25.40 % of 6000 mm/s.

The example shows the following values:

```
Speed (%)  Control      Value for DAC lookup
           voltage (V)  table (% of 10 V)
-----------------------------------------
```

```
0.00       3.0 *        30 *
25.40      3.0          30
50.79      3.2          32
76.19      3.5          35
100.00     4.2          42

* The control voltage for 0.00 \% speed is
  copied from the row below.
```

Apply the laser control voltages to the lookup table

53. In the Navigator view, expand Devices and click **onthefly**.
54. In the Node Properties view, enter the measured % of 10 V values into the rightmost (Power 100.00 %) column of the DAC lookup table.

Set the velocity thresholds

55. In the Navigator view, click Devices and then right-click **onthefly**.
56. In the context menu, click **Show in Inspector** → **New window**.
57. In the Inspector view, expand **Aootf**.
58. Set ScanActiveityPosOffset to **25.0**.
59. Set ThresholdSwitchCont to the work piece velocity (in mm/s) above which you want the system to switch from segmented to continuous (Always-On) On-The-Fly operation.

    ThresholdSwitchCont must be greater than ThresholdSwitchSegm.
60. Set ThresholdSwitchSegm to the work piece velocity (in mm/s) below which you want the system to switch from continuous (Always-On) to segmented On-The-Fly operation.

    ThresholdSwitchCont must be greater than ThresholdSwitchSegm.

Set the DAC channel

61. In the Inspector view of the onthefly device, expand **DAC** → **LUT**.
62. Set Channel to the same DAC channel as in the laser device configuration.

Restore settings and save configuration to finish the procedure

63. In the Navigator view, expand Devices and click **onthefly**.
64. Optionally but highly recommended, on the DAC LUT tab, click **Save to file**.

    Note, that the values are not automatically committed to the controller and that committing them to the controller overwrites the values stored on the controller.
65. Click **Commit to controller**.
66. In the Navigator view, expand **Pens** → **default (systempen)** and click <**your laser**>.
67. On the Control tab, set Power to **100 %**.
68. On the Osc, set the laser pulse **Frequency** and the **On-time** (pulse duration) to values that are appropriate for normal (segmented) On--The-Fly operation at e.g., 6000 mm/s.
69. In the InScript main menu, click **Controller** → **Save configuration**.

    Your system is prepared for Always-On On-The-Fly operation.

14.9.7 Usage

14.9.7.1 Editing values

TIP

To reduce the amount of values to edit see section Editable Matrix.

Procedure

1. On the DAC LUT tab and the respective Table sub tab, click the value in a cell you want to edit.
2. Edit the value.

   Values from 0.0 % to 100.0 % are allowed.
3. Press the **ENTER** or **TAB** key or click outside the cell to accept the value.

Depending on the setting of Auto interpolate interpolation between the neighboring editable cells is applied.

Below the table, the graph representation is updated immediately.

4. Enter all necessary values this way.

   Note, that the values are not automatically committed to the controller and that committing them to the controller overwrites the values stored on the controller.

5. Click **Commit to controller** to send the new values to the controller.

14.9.7.2 Table names

Procedure

- On the DAC LUT tab and the respective Table sub tab, edit Name and press the **Enter** key.

  The current selected DAC LUT table shows the new name now.

14.9.7.3 Editable matrix

The DAC LUT table consists of a matrix of 64x64 cells. To not have to edit the value of each cell, it is possible to reduce the amount of editable cells and to hide the non-editable ones. The values in non-editable cells are interpolated then.

Procedure

1. On the DAC LUT tab and the respective Table sub tab, in Editable matrix select the amount of editable cells.
2. Optionally activate **Hide non-editable fields**.

In the graphs below the table non-editable ’cells’ are shown in a different color. There also the interpolation can be seen, if the non-editable ’cells’ are hidden.

14.9.7.4 Loading table values from a file

Procedure

1. On the DAC LUT tab and the respective Table sub tab, click **Load from file...**.

   Note, that the values are not automatically committed to the controller and that committing them to the controller overwrites the values stored on the controller.

2. Click **Commit to controller**.

   This overwrites the values on the controller.

14.9.7.5 Saving table values to a file

The file format of the DAC LUT table is CSV based. It consists of 64 lines, each line consists of 64 values separated by a semicolon. Each value has a range between 0 and 65535 where 0 equals 0 % and 65535 equals 100 %.

Procedure

- On the DAC LUT tab and the respective Table sub tab, click **Save to file...**.

  Note that table names are not stored in LUT files. Assign a meaningful file name.

14.9.7.6 Automatic interpolation

If Auto interpolate is activated and the Editable matrix is not set to 64x64, then an automatic interpolation is performed each time a value is entered into the table. The automatic interpolation only interpolates all values in non-editable cells between the currently entered value and the neighboring editable cells. If a value was entered into a different cell which is no longer editable, then it might be overwritten by the interpolation.

If Auto interpolate is deactivated, then the manual interpolation interpolates all non-editable fields.

Procedure

- On the DAC LUT tab and the respective Table sub tab, activate or deactivate **Auto interpolate**.

14.9.7.7 Manual interpolation

If Auto interpolate is deactivated, then the manual interpolation interpolates all non-editable fields.

Procedure

- On the DAC LUT tab and the respective Table sub tab, click **Interpolate**.

14.9.7.8 Committing the DAC LUT to the controller

Note, that the values are not automatically committed to the controller and that committing them to the controller overwrites the values stored on the controller.

Procedure

- On the DAC LUT tab and the respective Table sub tab, click **Commit to controller**.

14.9.7.9 Reverting DAC LUT to the values stored on the controller

Procedure

- On the DAC LUT tab and the respective Table sub tab, click **Revert to controller values**.

14.9.7.10 Resetting the DAC LUT to default values

Procedure

1. On the DAC LUT tab and the respective Table sub tab, click **Reset to default values**.

   Note, that the values are not automatically committed to the controller and that committing them to the controller overwrites the values stored on the controller.

NOTICE

The default values are set so that the laser power is always

100 % of the optical power percentage that is set in the pen.

- In the pen, make sure that the power is set to the desired percentage.

2. Click **Commit to controller**.

15 Variable Tree

Using the InScript Inspector, you can access the complete variable tree on the controller.

stat

15.1 stat

Inside the `stat` variable subtree you will find information about the current controller status that are especially used for diagnosis purposes.

memory

disk

15.1.1 memory

In the variable subtree `stat.memory` you will find information about the memory (RAM) of the controller.

total The total memory in megabytes of the controller. This value does not change.

used The currently used memory in megabytes.

free The available memory in megabytes. Even if this value gets low this may not cause a problem because the underlying Linux operating system will use memory for its own purposes such as cache or buffers that will be freed as soon as the InScript firmware requests more memory from the system.

15.1.2 disk

Information about the used and free persistent flash memory is located the subtree `stat.disk`. The name disk is used because this is the memory where the operating system files and user files are located and this is equivalent to a hard disk on a pc.

sys The subtree `sys` contains information about the system partition of the controller. This partition is used for the operating system and installed firmware. During normal operation this file system is read-only and its free space should not change unless you are running an installation.

sys.total The total memory in megabytes of the sytem partition.

sys.used The used space in megabytes of the sytem partition.

sys.free The free space in megabytes of the sytem partition.

user The subtree `user` contains information about the partition where log-files, user data (e.g. jobs, pens etc.) and temporary files are stored. The directory folders that are shared and accessible from a pc are also located in this user partition.

user.total The total memory in megabytes of the user partition. On the linux filesystem of the controller, the mountpoint of this partition is `/var`.

user.used The used space in megabytes of the sytem partition.

user.free The free space in megabytes of the sytem partition.

16 References

16.1 External documents

16.1.1 Managing devices

See InScript User Manual, section Managing Devices

16.1.2 Working with pens

See InScript User Manual, section Working With Pens

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