

# How to set up ScanPack control and primitives in ScanMaster™ Designer for the SMC

## 1 Introduction

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This Application Note describes how to set up ScanPack control and primitives, for the ScanMaster™ Contoller (SMC), in ScanMaster™ Designer (SMD).

The following sections are included in this Application Note:

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**Keywords:** ScanPack, Max Radial Error, Skywriting, ScanMaster™ Contoller, SMC, ScanMaster™ Designer, SMD, point primitive, vector primitive, circle primitive, spiral primitive, Device Configuration

## 2 ScanPack: trajectory planning and four primitives

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**SMC has two control modes: Traditional and ScanPack.** ScanPack is an innovative control scheme, which plans and optimizes the scanner moving trajectory based on scanning-system capability as well as the user's accuracy requirements. The capability of the scanning system is defined by servo parameters that are loaded into the SMC. Unlike the Traditional control mode, ScanPack does not rely on delay settings (Mark Delay, Jump Delay and Poly Delay) to optimize the process. Instead, it relies on end-user input for the accuracy requirement, (for example, Max Radial Error for corners). In addition, ScanPack doesn't require that a fixed jump speed be defined, instead it uses the system-allowed maximum capability to do the jump.

In the Traditional control mode, the marking patterns are always interpreted as points or vectors. However, ScanPack offers two additional shape primitives: Circle, and Spiral. These primitives can greatly simplify shape optimization to create accurate shapes.

## 3 System prerequisites

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- The scanner must be tuned for ScanPack operation.
- The scanner must be connected to the SMC through XY2-100 or GSBUS.
- The SMC is connected to the computer through Ethernet.
- SMC SDK and SMD (v2.0 or later) must be installed on the computer.

**NOTE:** To install SMC SDK and SMD on the computer, refer to Application Note APN\_SMC\_006A ("Quick Startup Guide for the ScanMaster™ Controller").

- The Lightning™ II servo parameters have been loaded onto the SMC.

**NOTE:** To load Lightning™ II servo parameters onto the SMC, refer to Application Note APN\_SMC\_010A ("How to upgrade firmware and load Lightning™ II servo parameters".)

**NOTE:** As of this writing, ScanPack mode only supports the Lightning™ II scanning system. It is anticipated that support of ScanPack for other scanners will be available soon.

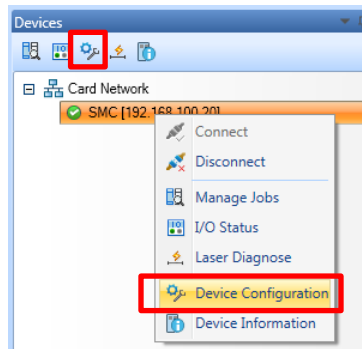
## 4 Configure the SMC for ScanPack control

The following subsections describe how to configure the SMC for ScanPack control:

- ["Select the ScanPack Command Generation Mode"](#) (below)
- ["Load the Lightning™ II servo parameters onto the SMC"](#) on page 3

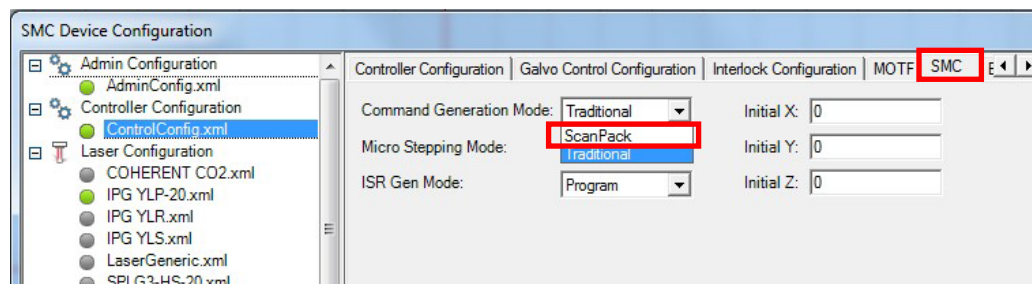
### 4.1 Select the ScanPack Command Generation Mode

Do the following to select ScanPack control mode for the SMC:



**Figure 1 - 2 ways to open Device Configuration in SMD**

2. In SMC Device Configuration, highlight "ControlConfig.xml" in the list on the left. Under "SMC" tab on the right, select *ScanPack* in the dropdown list for **Command Generation Mode**.



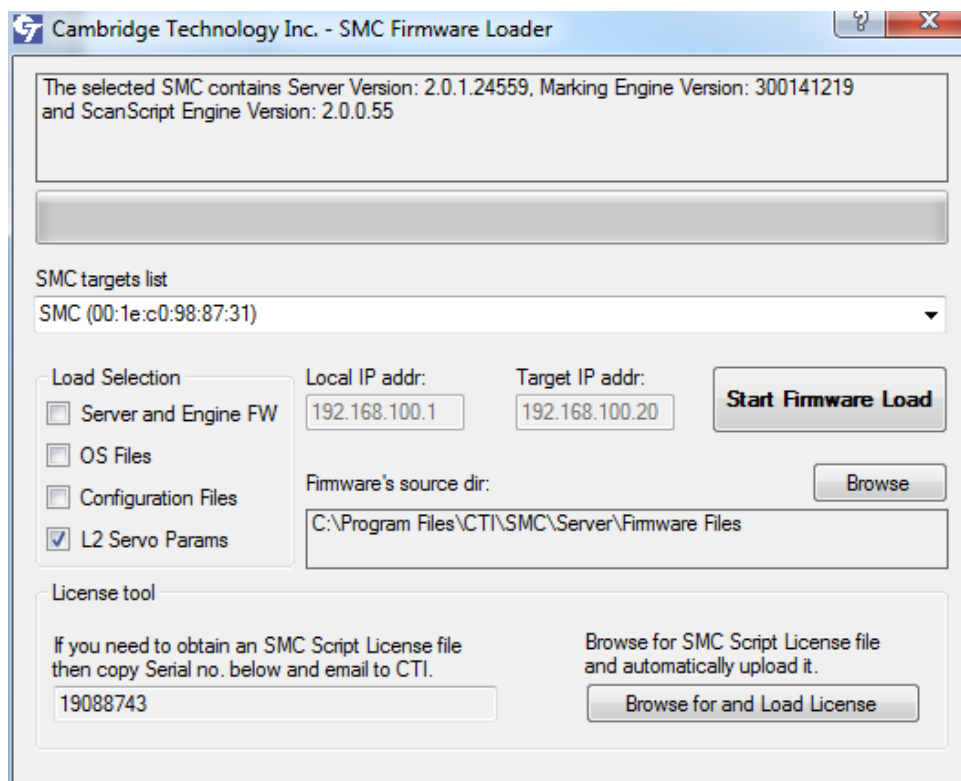
**Figure 2 - Select 'ScanPack' in Command Generation Mode**

## 4.2 Load the Lightning™ II servo parameters onto the SMC

Do the following to load the Lightning™ II servo parameters onto the SMC:

1. Check that the Lightning™ II servo boards are properly connected to the computer via the USB cable. Then power on the Lightning™ II servo boards.
2. Check that the SMC board is properly connected to the computer, and then power on the SMC board.
3. Launch SMC Firmware Loader (either from the Windows start-up menu or from the folder **C:\Program Files\CTI\SMC\Server**). SMC Firmware Loader will search the Ethernet network for the SMC.

When an SMC is found, it appears in the **SMC targets list**. The message window will display the **Server Version**, the **Marking Engine Version**, and the **ScanScript Engine Version** as shown in the following figure.



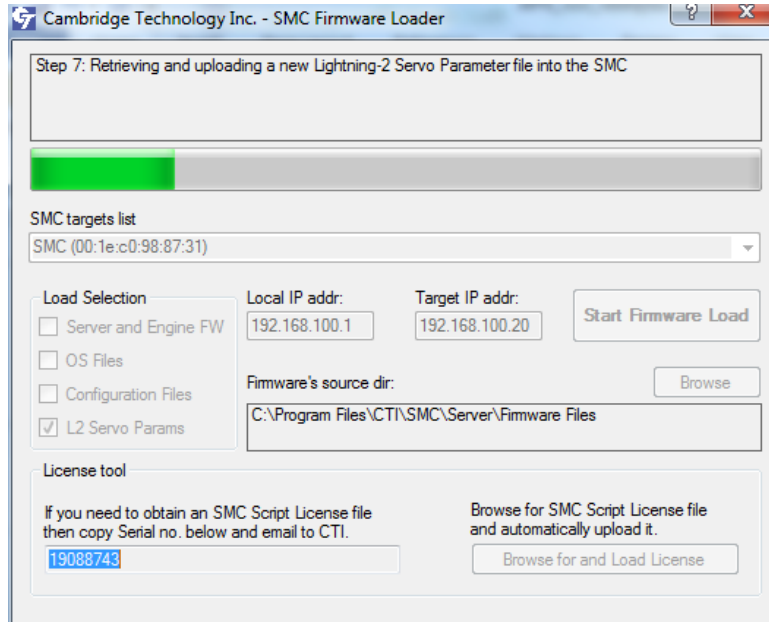
**Figure 3 - “L2 Servo Params” and Start Firmware Load**

4. In the **Load Selection** area of the above screen, select the **L2 Servo Params** check box.

**NOTE:** Do not select any of the other check boxes in the **Load Selection** area; the goal of this procedure is only to load the Lightning™ II servo parameters.

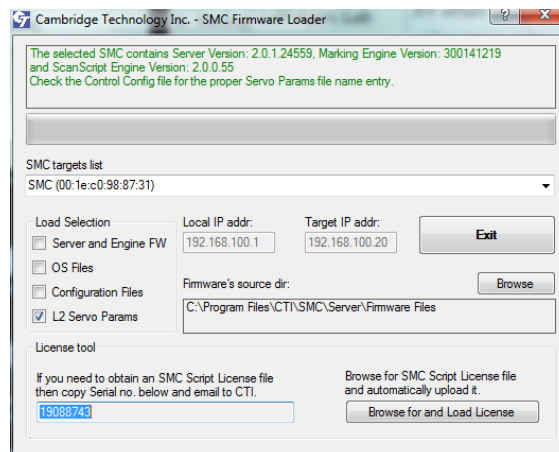
5. Left-click the **Start Firmware Load** button in the above screen. This will start the process of loading Lightning™ II servo parameters into the SMC.

The major step in this process is “Step 7: Retrieving and uploading a new Lightning™ II Servo Parameter file into the SMC” as shown in the following figure.



A configuration file with the default name **ServoParams.xml** is automatically generated in the SMC, and the Control Configuration file has the default name **ServoParams.xml**. **PLEASE DO NOT CHANGE ANY SERVO PARAMETERS IN THE CONFIGURATION FILE.** Modifying these parameters will result in servo parameter mismatches between the SMC and the Lightning™ II scanning system. This means that the scanner control will be not optimized or even stable.

- After the servo parameter upload is complete, the message window of the following screen will display the current SMC firmware version and a message saying “Check the Control Config file for the proper Servo Params file name entry.” **IT IS RECOMMENDED THAT YOU NOT CHANGE THE SERVO PARAMS FILE NAME.**



**Figure 5 - Lightning™ II servo upload completed**

7. Left-click the **Exit** button in the above screen to close SMC Firmware Loader. This concludes the Lightning™ II servo parameter upload process.

## 5 Set up laser timing for ScanPack jobs

This section describes how to set the global parameters and shape-level parameters for the laser timing of ScanPack jobs.

### 5.1 Setting the global parameters for laser timing in Device Configuration

Do the following to set the global parameters for the laser timing of ScanPack jobs:

1. Display the SMC Device Configuration window as described in Section 4.1 ("Select the ScanPack Command Generation Mode") on page 2.
2. Select ScanPack Parameters->L2InsGenConfig.xml in the SMC Device Configuration window. This displays the Laser tab in the Device Configuration window.

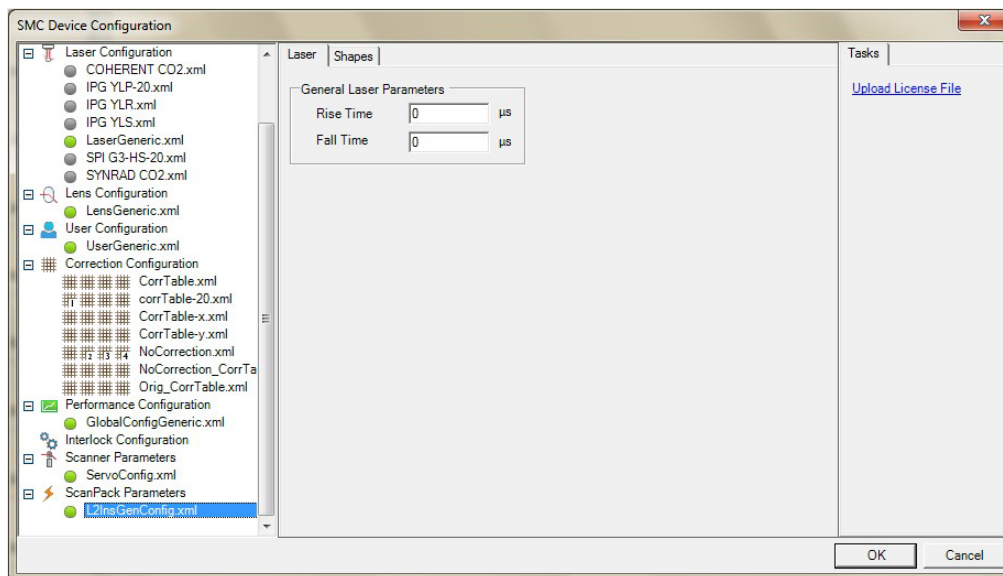


Figure 6 - The Laser tab under ScanPack Parameters

3. Enter values for the following parameters on the **Laser** tab:

- **Rise Time** – The actual laser rise time in microseconds. This global value—together with the **Laser On Delay** setting for the individual shape—determines when the laser is turned on.

If **Rise Time** is a positive value, the ScanPack control will turn on the laser *before* the scanner reaches the start of the marking vector by this value (equivalent to the effect of a negative **Laser On Delay**).

If **Rise Time** is a negative value, the ScanPack control will turn on the laser *after* the scanner reaches the start of the marking vector by this value (equivalent to the effect of a positive **Laser On Delay**).

The maximum value for **Rise Time** is equal to the **Link Settle Time Constant** for primitives, which is defined in the **Shapes** tab of **L2InsGenConfig.xml**.

- **Fall Time** – The actual laser fall time in microseconds. This global value—together with the **Laser Off Delay** setting for the individual shape—determines when the laser is turned off.

If **Fall Time** is a positive value, the ScanPack control will turn off the laser *before* the scanner reaches the end of the marking vector by this value (equivalent to the effect of a negative **Laser Off Delay**).

If **Fall Time** is a negative value, the ScanPack control will turn off the laser *after* the scanner reaches the end of the marking vector by this value (equivalent to the effect of a positive **Laser Off Delay**).

## 5.2 Setting the shape-level parameters for laser timing in Device Configuration

The **Laser On Delay** setting and the **Laser Off Delay** setting determine how the respective **Rise Time** and **Fall Time** settings affect the marking of individual Shapes.

Both settings (**Laser On Delay** and **Laser Off Delay**) are on the **Quality** tab of the **Laser Properties** window in the ScanMaster™ Designer (SMD) GUI. Refer to the *ScanMaster™ Designer User Guide* for more information on how to access the **Quality** tab of the **Laser Properties** window for a Shape.

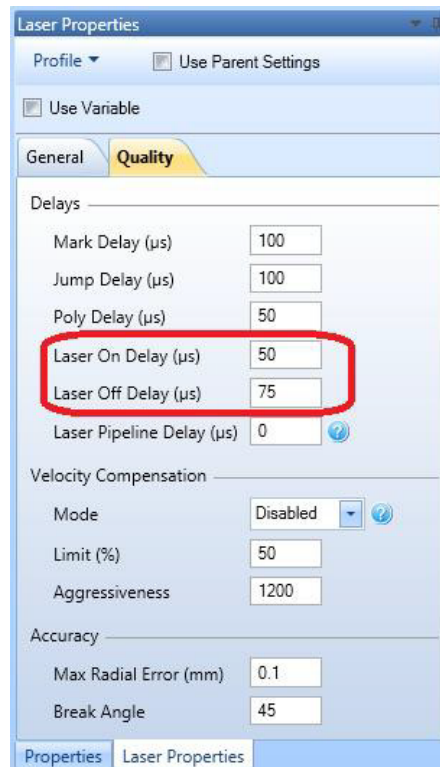


Figure 7 - Laser On Delay and Laser Off Delay

### 5.2.1 The effect of Laser On Delay on Rise Time

The value of **Laser On Delay** is added to **Rise Time**, and the result dictates when the laser will be turned on relative to the time the scanner reaches the marking start point. For example, if **Rise Time** is set to 50 μs and Laser On Delay is set to 40 μs, the effective laser on delay will be  $(-50\mu s) + 40\mu s$  or  $-10\mu s$ ; the laser will be turned on 10μs before the scanner reaches marking start point.

**NOTE:** **Rise Time** is a global parameter, which will be applied to all shapes in all jobs that are loaded into SMD. **Laser On Delay** is a shape-level parameter, and it can be different from shape to shape, and job to job. Laser On/Off delays are usually used for fine tuning the laser timing.



### 5.2.2 The effect of Laser Off Delay on Fall Time

The value of **Laser Off Delay** is added to **Fall Time**, and the result dictates when the laser will be turned off relative to the time the scanner reaches the marking end point. For example, if **Fall Time** is set to 50  $\mu\text{s}$  and Laser On Delay is set to 40  $\mu\text{s}$ , the effective **Laser Off** delay will be  $(-50\mu\text{s}) + 40\mu\text{s}$  or  $-10\mu\text{s}$ ; the laser will be turned off 10 $\mu\text{s}$  before the scanner reaches the marking end point.

**NOTE:** **Fall Time** is a global parameter, which will be applied to all shapes in all jobs that are loaded into SMD. **Laser Off Delay** is a shape-level parameter, and it can be different from shape to shape, and job to job. Laser On/Off delays are usually used for fine tuning the laser timing. Fall Time can only be set to a positive value.

## 6 Set up primitive properties for ScanPack Jobs

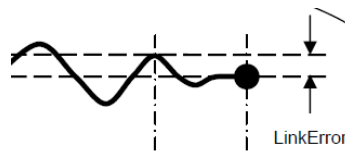
There are two places for ScanPack users to set up parameters for the four primitives (point, vector, circle and spiral):

1. 'Properties' and 'Laser Properties' in a job through ScanMaster™ Designer GUI;
2. Device Configuration -> ScanPack Parameters -> L2InsGenConfig.xml, under 'Shape' tab

Similar to laser timing settings discussed, the difference is that the former settings are the parameters at the individual shape level, while the latter settings are at the configuration level and will apply to all similar shapes in all the jobs.

**Note:** For all primitives, Jump speed and Mark/Jump/Poly delays in "Properties" and "Laser Properties" in the SMD GUI are not applicable with ScanPack control mode, and they need not be defined.

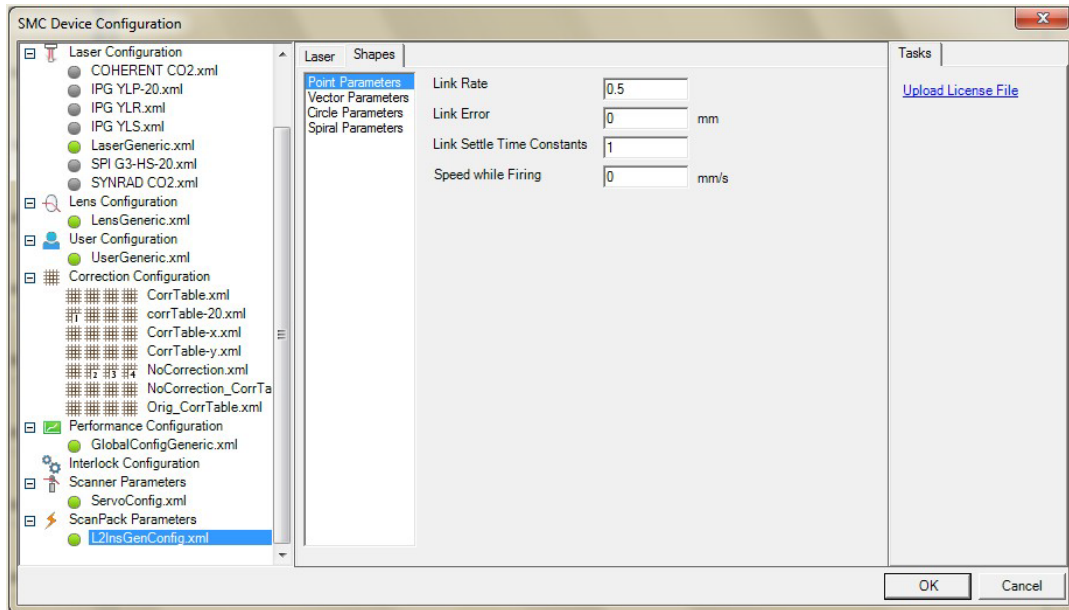
### 6.1 Point primitive



**Figure 8 - Point primitive**

Do the following to set the global parameters for the point primitive:

1. Select Point Parameters on the Shapes tab in Device Configuration -> ScanPack Parameters -> L2InsGenConfig.xml.



**Figure 9 - Point Parameters**

2. Edit the following parameters:

- **Link Error** – Jump to final position accuracy before firing the laser.
- **Link Settle Time Constant** – After the jump into final position accuracy (defined by **Link Error**), this is how much extra time you want the system to continue to settle before firing the laser. The actual time is this value times  $50\mu\text{s}$ .
- **Speed while Firing** – The speed of the scanner while firing at the point

Do the following to set the shape-level parameters for points (dots):

1. Draw points (dots) in the ScanMaster™ Designer GUI: click on **Insert Dot** on the **Drawing Shape** toolbar, and place the dot at the desired position.



**Figure 10 - Insert Dot**

2. Define the properties of the dots in ScanMaster™ Designer GUI: on the **Properties** tab, define **Location** and **Dot Duration (μs)**. Define all other necessary parameters on the **Laser Properties** tab.

**NOTE:** **Jump Speed** and the **Mark/Jump/Poly** delays are not applicable for ScanPack mode. **Mark Speed**, the wobble properties, **Velocity Compensation**, **Max Radial Error** and **Break Angle** do not apply to the point primitive.

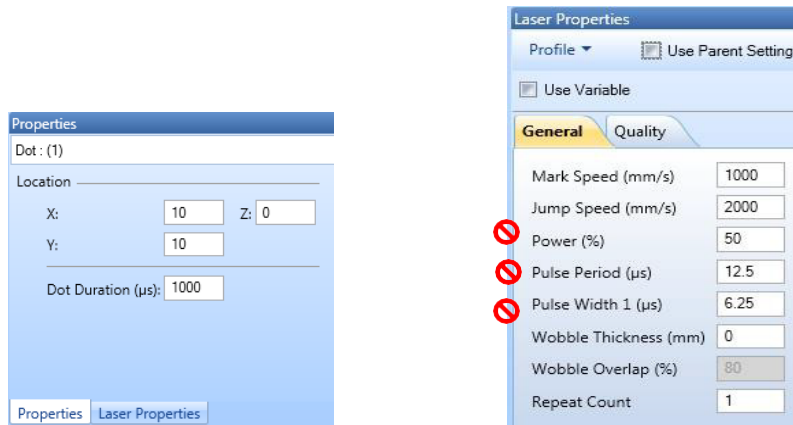


Figure 11 - Properties and Laser Properties for dots

## 6.2 Vector Primitive

Do the following to set the global parameters for the vector primitive:

1. Select Vector Parameters on the Shapes tab in Device Configuration -> ScanPack Parameters -> L2InsGenConfig.xml.

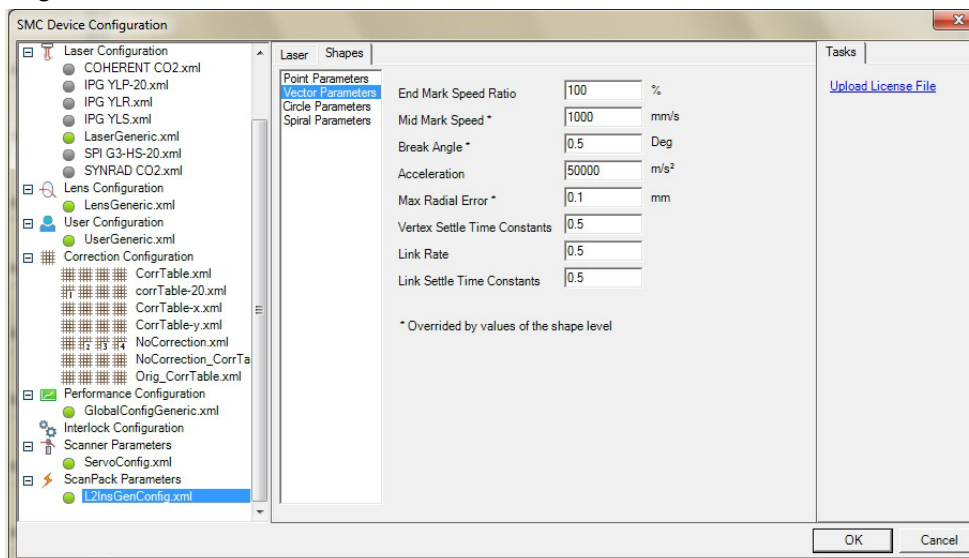


Figure 12 - Vector Parameters

2. Edit the following parameters:

- **End Mark Speed Ratio** – The speed at the end of vector versus the speed at the middle of vector.
- **Mid Mark Speed** – The default mark speed for vectors (overridden when **Mark Speed** is defined in the **Laser Properties** tab)
- **Break Angle** – The default break angle for vectors (overridden when **Break Angle** is defined in the **Laser Properties** tab)
- **Acceleration** – The default value for acceleration from End-to-Mid velocity and Mid-to-End velocity
- **Max Radial Error** – The default **Max Radial Error** for vectors (overridden when **Max Radial Error** is defined in the **Laser Properties** tab)
- **Vertex Settle Time Constants** – The extra time you want the system to settle on the vector vertex after skywriting loop before firing the laser (see **Figure 14 - Max Radial Error and Skywriting loop on page 11**). The actual time is this value times 50µs.
- **Link Rate** – This sets the velocity and the acceleration of the scanner to do jumps. If you set **LinkRate** to 0.5, ScanPack will use 50% of **MaxVelocity** and **MaxAccel** (which are defined in the scanner parameters) to do the jump.
- **Link Settle Time Constant** – After the jump into final position accuracy (defined by **Link Error**), this is how much extra time you want the system to continue to settle before firing the laser. The actual time is this value times 50µs.

Do the following to set the shape-level parameters for vector shapes:

1. Draw vector shapes, such as boxes, in the ScanMaster™ Designer GUI.
2. For each vector shape, define the parameters on the **Properties** and **Laser Properties** tabs in the ScanMaster™ Designer GUI.

**NOTE: Jump Speed and Mark/Jump/Poly delays are not applicable for ScanPack mode.**

The **Velocity Compensation** and **Accuracy** sections of the **Laser Properties** tab contain unique parameters for the vector primitive.

- a. In “Laser Properties” under “Quality” (Figure 13), **Velocity Compensation** section defines the parameters for Velocity-based Laser Modulation -

**Mode: Disabled, Duty Cycle, Frequency or Power.** The user can disable the mode, or he can control laser via Duty Cycle, Frequency or Power.

**Limit (%):**

- i. If power or duty cycle mode is used, limit of maximum compensation is *an absolute power % level*. Make sure this limit value is set smaller than the power or duty cycle value set for the marking job.

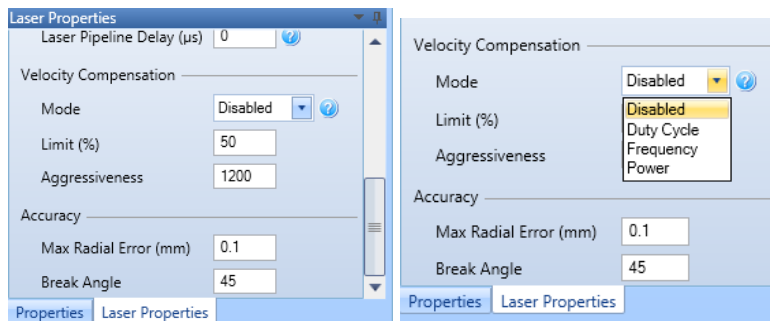
For example, when Mode is chosen to be Power, in a marking job if the user sets power % for marking to be 90% and in velocity compensation he sets the limit to be 15%, then when the scanner slows down around a corner, or at the start or end of a vector, the power varies from 15% *absolute* power level at the minimum velocity to 90% *absolute* power level at the nominal marking speed. However, if the power % is wrongly set to be higher than the marking power, e.g. 95%, the power will then rise to 95% *absolute* power level at the

minimum velocity and drop down to 90% *absolute* power level at the nominal marking speed, and the user will get incorrect compensation.

- ii. If frequency mode is used, the limit is *a percentage of* the normal marking power setting. Its range is zero (full-range compensation) to 100% (no compensation).

For example, when Frequency mode is used, in a marking job if the user sets the frequency for marking to be 90kHz and in velocity compensation he sets the limit to be 15%, then when the scanner slows down around a corner, or at the start or end of a vector, the frequency varies from 13.5kHz at the minimum velocity to 90kHz at the nominal marking speed.

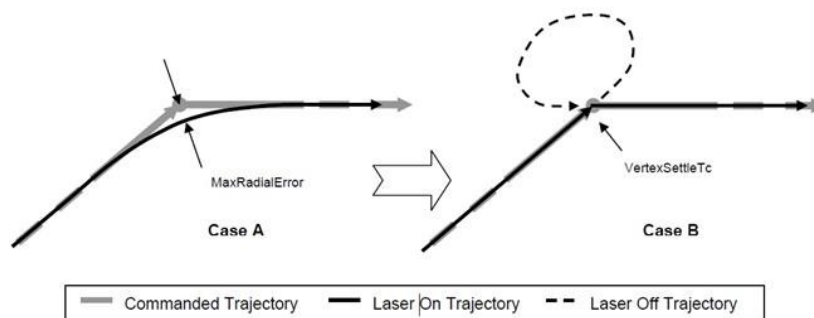
**Aggressiveness:** tuning bandwidth of the servos, in units of Hz. This value should match the bandwidth that the system is tuned at. It's usually a trial-and-error exercise for the user to find the best value to set the bandwidth. A good starting value can be the reciprocal of the scanner's small step response.



**Figure 13 - Velocity Compensation**

b. User defines job accuracy In **Accuracy** section-

**Max Radial Error (mm):** maximum allowable error from vector vertex to the actual marking path (rounded corner) (see Figure 14). When the scanner can achieve the specified accuracy with the current mark speed, the scanner will go around the corner without the skywriting loop and the corner sharpness is ~70% of the Max Radial Error. When the scanner cannot achieve the specified accuracy with the current mark speed, the skywriting loop is triggered and the corner will be sharp with zero radial error.



**Figure 14 - Max Radial Error and Skywriting loop**

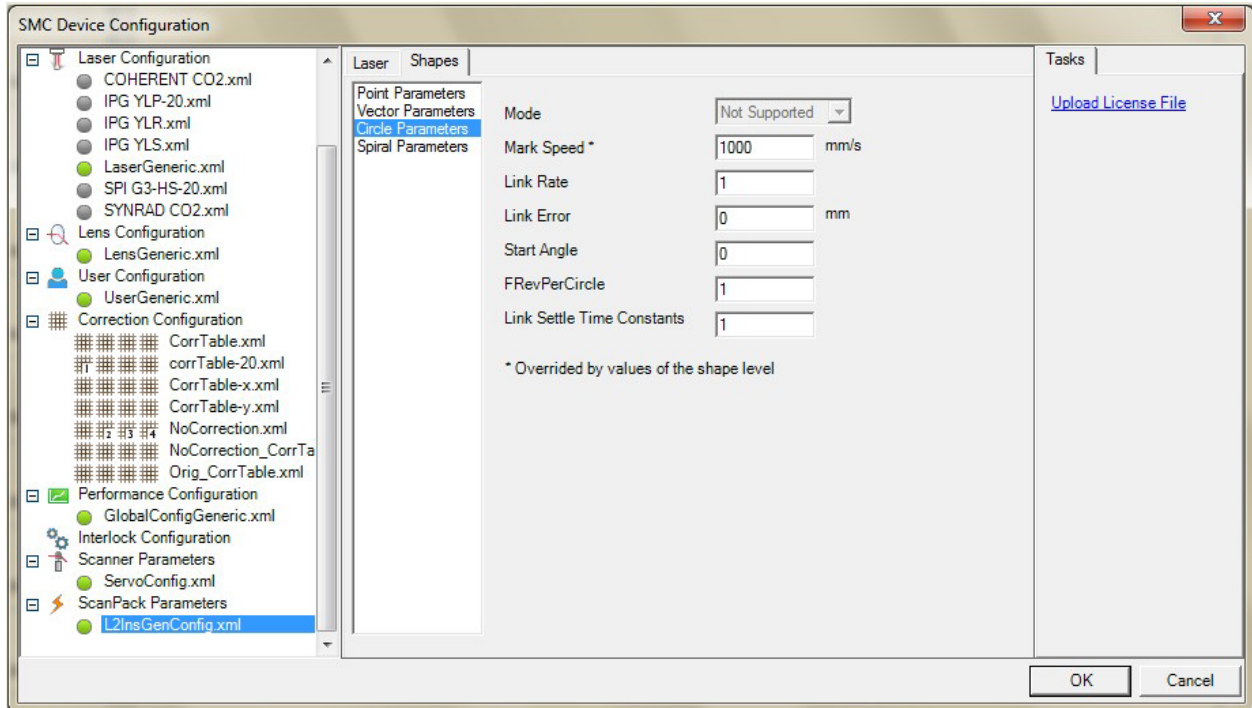
**Break Angle:** the angle beyond which the skywriting loop mode is inhibited even though the the scanner cannot achieve the specified accuracy with the current mark. It is **NOT** recommended to use Break Angle unless absolutely needed as the scanner accuracy may be compromised.

### 6.3 Circle primitive

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Do the following to set the global parameters for the circle primitive:

1. Select Circle Parameters on the Shapes tab in Device Configuration -> ScanPack Parameters -> L2InsGenConfig.xml.





**Figure 15 - Circle Parameters**

2. Edit the following parameters:

- **Mark Speed** – The default mark speed for circles (overridden when **Mark Speed** is defined in the **Laser Properties** tab)
- **Link Rate** – This sets the velocity and the acceleration of the scanner to do jumps. If you set **LinkRate** to 0.5, ScanPack will use 50% of **MaxVelocity** and **MaxAccel** (which are defined in the scanner parameters) to do the jump.
- **Link Error** – Jump to final position accuracy before firing the laser.
- **FRevPerCircle** – How many cycles of the circle the user wants to draw. It can be a non-integer number, for example, 0.35 or 5.43.  
**NOTE:** In ScanMaster™ Designer design view, the user can also draw an arc to create an effect similar to that of **Start Angle** and **FRevPerCircle**.
- **Link Settle Time Constant** – After the jump into final position accuracy (defined by **Link Error**), this is how much extra time you want the system to continue to settle before firing the laser. The actual time is this value times 50µs.

Do the following to set the shape-level parameters for circles and arcs:

1. Draw circles in the ScanMaster™ Designer GUI: click  on the **Drawing Shape** tool bar and draw circles, or click  to draw an arc. Under ScanPack control mode, both shapes will use circle primitive.



2. For each circle or arc, define the parameters on the **Properties** and **Laser Properties** tabs of the ScanMaster™ Designer GUI.

**NOTE:** **Jump Speed** and the **Mark/Jump/Poly** delays are not applicable for ScanPack mode, and **Max Radial Error** does not apply to the circle primitive. **Mark Speed** is maintained along the circle or arc, so **Velocity Compensation** does not apply either.

## 6.4 Spiral primitive

Do the following to set the global parameters for the spiral primitive:

1. Select **Spiral Parameters** on the **Shapes** tab in **Device Configuration -> ScanPack Parameters -> L2InsGenConfig.xml**.

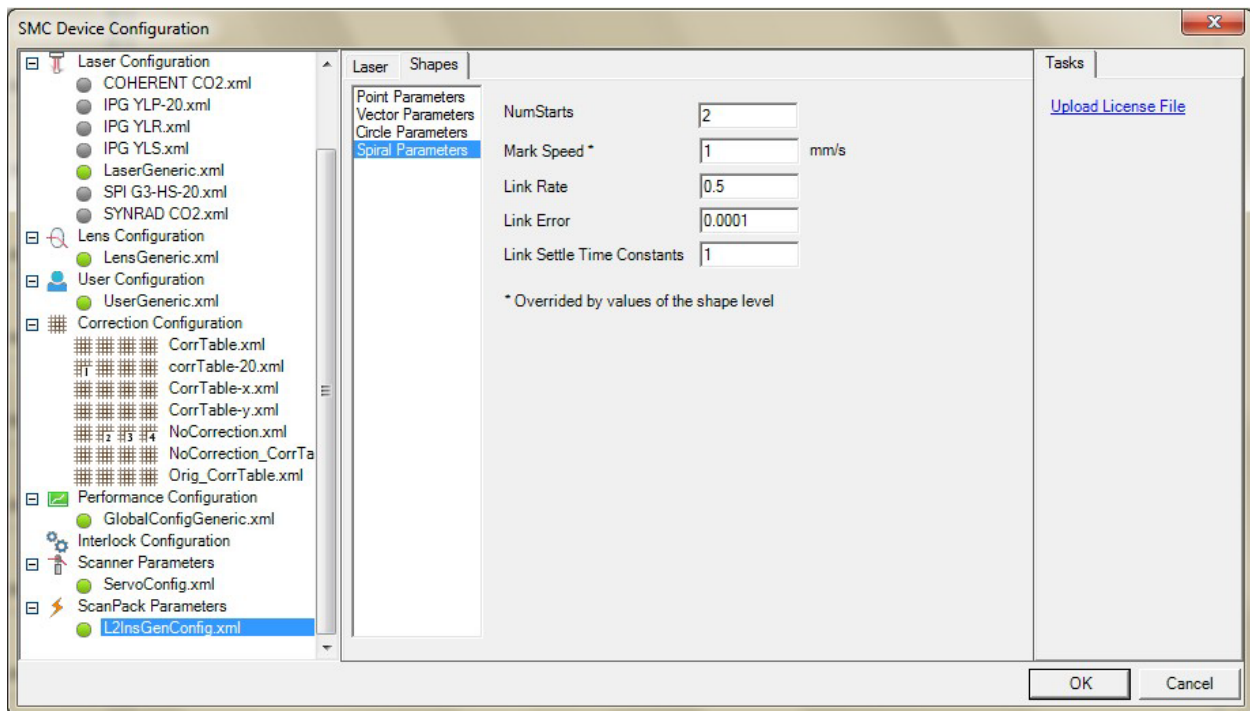


Figure 16 - Spiral Parameters

2. Edit the following parameters:

- **NumStarts** – The user can have multiple start points for spiral. The first start is always on the positive X axis, with additional ones distributed evenly around the circumference of the spiral, as shown in the following figure.




**Figure 17 - Spiral with 5 start points (NumStarts = 5)**

- **Mark Speed** – The default mark speed for spirals (overridden when **Mark Speed** is defined in the **Laser Properties** tab)

- **Link Rate** – This sets the velocity and the acceleration of the scanner to do jumps. If you set **LinkRate** to 0.5, ScanPack will use 50% of **MaxVelocity** and **MaxAccel** (which are defined in the scanner parameters) to do the jump.
- **Link Error** – Jump to final position accuracy before firing the laser.
- **Link Settle Time Constant** – After the jump into final position accuracy (defined by **Link Error**), this is how much extra time you want the system to continue to settle before firing the laser. The actual time is this value times 50µs.

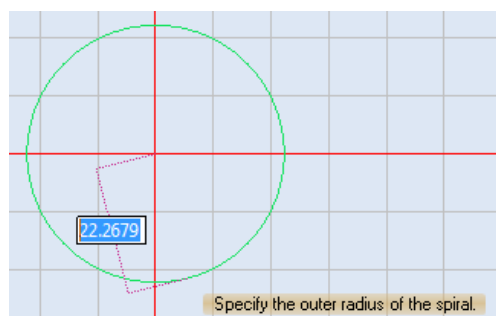
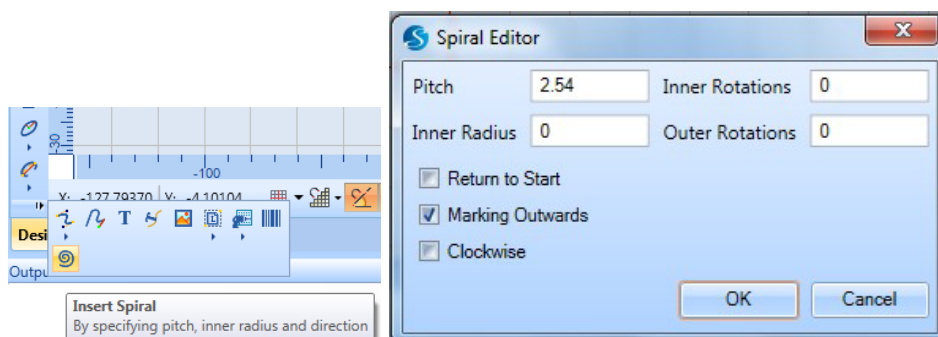
Do the following to set the shape-level parameters for spirals:

1. Draw spirals in ScanMaster™ Designer GUI: click  on the **Drawing Shape** tool bar. A pop-up window will ask you to define the spiral by setting the following parameters:

- **Pitch** – The distance between succeeding lines inside the spiral.
- **Inner Radius** – The distance to the innermost point from the center of the spiral
- **Inner Rotations** – The number of rotations on the inner circle of the spiral
- **Outer Rotations** – The number of rotations on the outer circle of the spiral
- **Return to Start** – If this check box is selected, the beam will return to the start point.
- **Marking Outwards** – The start point of the spiral, start from the center.

**NOTE:** ScanPack currently only does Spiral primitive marking **inward**. The traditional mode is used for marking outward.

After clicking **OK** to close the Spiral Editor, the user is prompted to place the spiral at the desired location and define the Outer Radius, as shown in the following figure. (The Outer Radius defines the distance to the outermost point from the center of the spiral.)



**Figure 18 - Draw and define a Spiral**

2. For each spiral, define the parameters on the **Properties** and **Laser Properties** tabs of the ScanMaster™ Designer GUI.

**NOTE:** **Jump Speed** and the **Mark/Jump/Poly** delays are not applicable for ScanPack mode. **Max Radial Error** and **Velocity Compensation** are not applicable to the spiral primitive.

## 7 Referenced Documents

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This section lists the Application Notes and other documents that are referenced herein.

### 7.1 Referenced Application Notes

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The following table lists the Application Notes that are referenced herein.

**NOTE:** Unless otherwise noted, the current version of the following Application Notes is the applicable one.

**Table 1 - Referenced Application Notes**

Lit. No.	Title
AN00003	ScanMaster™ Controller Quick Startup Guide
AN00010	How to upgrade firmware and load Lightning™ II servo parameters

### 7.2 Other Referenced Documents

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The following table lists documents other than Application Notes that are referenced herein.

**NOTE:** Unless otherwise noted, the current version of any of the following documents is the applicable one.

**Table 2 - Other Referenced Documents**

Lit. No.	Title
N/A	ScanMaster™ Designer User Guide