

Manual (Software)

Global Drive *Cam Loader*



This Manual is valid for the **Global Drive Cam Loader** as of version 1.1

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Imprint

Lenze Drive Systems GmbH

POB 10 13 52, 31763 Hameln, Germany

Phone: ++49 (0)5154 / 82-0

Fax: ++49 (0)5154 / 82-2111

E-mail: Lenze@Lenze.de

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1 About this Manual

This Manual contains information about the **Lenze Global Drive Cam Loader V1.1**.




The Cam Loader is a software which is used to transfer recipes consisting of motion profiles, cam tracks and position markers from a PC to Lenze target systems.

Special features of the Cam Loader are:

- ▶ Import of CAD data via standardised interfaces (VDI 2143).
- ▶ Program operation via an easy-to-use PC user interface for the first commissioning and preparation of additional functions to be provided to the user by the mechanical engineer.
- ▶ Program control by means of script files from an IPC for automated processes without additional user entries and recipe extensions through the user.
- ▶ Smoothing of imported CAD data (motion profiles) for a smoother running of the drives.
- ▶ Recording of all important events.

1.1 Conventions used

This Manual uses the following conventions to distinguish between different types of information:

Type of information	Marking	Examples/notes
Variable name	<i>italics</i>	Set <i>bEnable</i> to TRUE to...
Window pane		The <i>message window...</i> / The <i>Options</i> dialog box...
Control element	bold	The OK button... / The Copy command... / The Properties tab... / The Name input field...
Sequence of menu commands		If the execution of a function requires several commands, the individual commands are separated by an arrow: Select File→Open to...
Keyboard command	<bold>	Use <F1> to call the Online Help. If a command requires a combination of keys, a "+" is placed between the key symbols: Use <Shift>+<ESC> to...
Program listings	Courier	IF var1 < var2 THEN
Keyword	Courier bold	a = a + 1 END IF
Link	<u>underlined</u>	Links are highlighted references which are activated by means of a mouse click.
Safety information		▶ Layout of the safety information (6)
Step-by-step instructions		Like safety information, step-by-step instructions and tips can be recognised by an icon.
Tip		

Global Drive Cam Loader

About this Manual

Layout of the safety information

1.2 Layout of the safety information

All safety information have a uniform structure:

- ▶ The icon characterises the type of danger.
- ▶ The signal word characterises the severity of danger.
- ▶ The note describes the danger and suggests how to avoid the danger.



Signal word

Note

Icon	Signal word	Meaning	Consequences if disregarded
 hazardous electrical voltage	Danger!	Impending danger to persons	Death or severe injuries
 general danger			
	Stop!	Potential damage to material	Damage to the controller or its environment
	Note!	Note	

2 System requirements

The following minimum requirements on hardware and software must be met in order to use the Cam Loader:

- ▶ Microsoft® Windows NT® 4.0 (as of Service Pack 5), Windows® 2000 (as of Service Pack 2) or Windows XP
- ▶ IBM®-compatible PC with Intel® Pentium® 90 processor
- ▶ 128 MB RAM
- ▶ 120 MB free hard disk capacity
- ▶ Pointer device (mouse, track ball, etc.)
- ▶ Free slots/interfaces according to the requirements of the fieldbus connection module used.

2.1 Connection with the target system

The communication with the target system (controller, Drive PLC, etc.) requires a fieldbus-specific interface module for the PC and the corresponding fieldbus modules for the target systems to be connected.

For system bus (CAN) communication, Lenze offers the following components as interface module for the PC:

Bus system		Max. number of target systems	
	PC port		Required hardware components
	System bus (CANopen)	63	
	Parallel port (LPT port)		PC system bus adapter 2173 incl. connection cable and voltage-supply adapter <ul style="list-style-type: none"> • for DIN keyboard connection (EMF2173IB) • for PS/2 keyboard connection (EMF2173IBV002) • for PS/2 keyboard connection with electrical isolation (EMF2173IBV003)
	USB (Universal Serial Bus)		PC system bus adapter 2177 incl. connection cable (EMF2177IB)

Global Drive Cam Loader

Software installation

3 Software installation



How to install the Cam Loader:

1. Start Windows.
2. Insert the Global Drive Cam Loader CD-ROM into your CD-ROM drive.
If the auto-start function of your CD-ROM drive is active the installation program is started automatically and you can proceed with step 5.
3. Select **Run ...** from the start menu.
4. Enter the letter for your CD-ROM drive followed by ":\setup.exe" (e.g. "e:\setup.exe") in the command line and confirm with **OK**.
5. Follow the instructions of the installation program.



Note!

Installation under Windows NT/2000/XP requires administrator rights!

4 Introduction

- ▶ The subsection [Cam Loader applications](#) describes the basic proceeding for different Cam Loader applications.
- ▶ The subsection [Creating/preparing import data](#) explains the data formats of the motion profiles, cam tracks and position markers required for data import. (📖 13)

4.1 Cam Loader applications

Depending on the application, the Cam Loader can be used with or without user interface. More information about this can be found in the following subsections:

- ▶ [Control with user interface \(GUI mode\)](#) (📖 10)
- ▶ [Control without user interface \(batch mode\)](#) (📖 11)
- ▶ [Commissioning of production machinery](#) (📖 12)

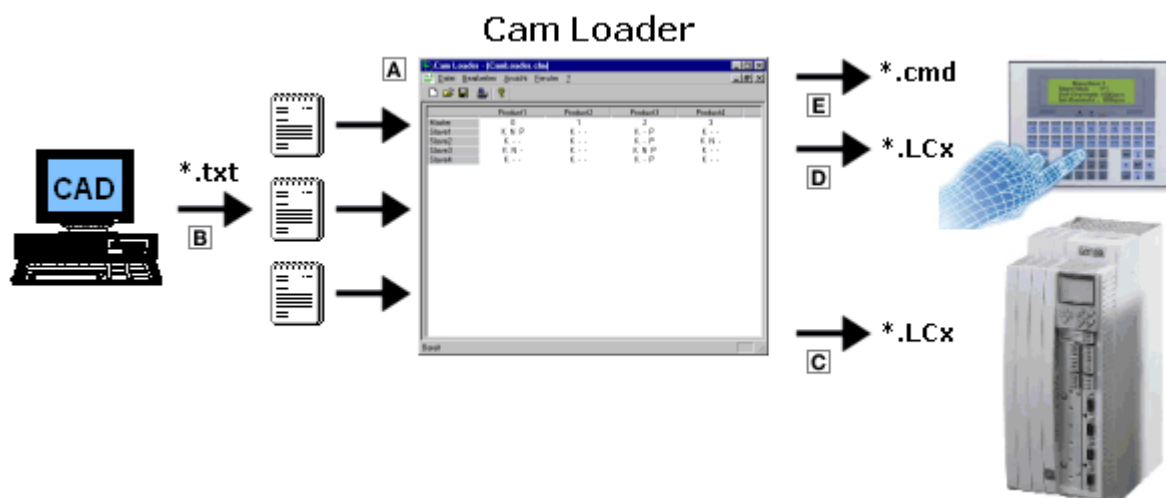
Global Drive Cam Loader

Introduction

Cam Loader applications

4.1.1 Control with user interface (GUI mode)

Control with user interface is required if a new project shall be created or prepared by the mechanical/automation engineer for the user.



Basic proceeding:

1. Use the user interface of the Cam Loader **A** and create a new Cam Loader project. The axes subdirectories for existing and future product data (motion profiles, cam tracks and position markers) are created automatically.
2. The Cam Loader assigns the product data **B**, which has e.g. been created by means of a CAD system and is available as tables of points according to VDI directive VDI 2143, to the corresponding axes/products.
3. Use the Cam Loader to create the LCx files for the target systems.
 - The LCx files can be directly transferred from the Cam Loader to the corresponding target systems **C**.
 - It is also possible to store the LCx files in other control devices (e.g. a PLC or an IPC) for subsequent downloads **D**.
4. As an option, the Cam Loader can automatically create a script file for the Cam Loader project which can be used to start the Cam Loader without user interface, e.g. on an IPC **E**.



Note!

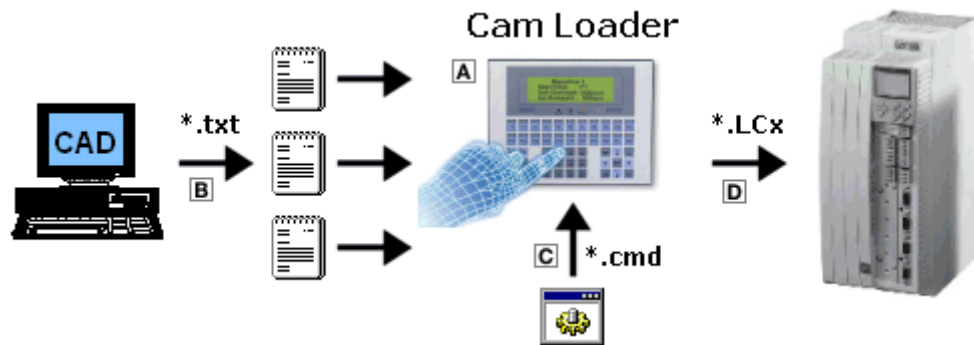
Use of LCx files:

- LC9 for Servo PLC and ECSEA...
- LC7 for servo cam 9300EK

4.1.2 Control without user interface (batch mode)

It is also possible to start the Cam Loader without user interface (batch mode).

- ▶ In this case, a script file is used for control. The script file can be created by the user himself using a traditional text editor or automatically generated for a project by the Cam Loader.
- ▶ Through this functionality, it is possible to use the Cam Loader on an IPC without user interface which is, in turn, operated via an HMI. For this purpose, the IPC must, of course, meet the system requirements of the Cam Loader.



Basic proceeding:

1. The mechanical/automation engineer prepares the IPC for the user:
 - He installs the Cam Loader on the IPC **A**.
 - He creates a Cam Loader project and thus the axes subdirectories for existing and future product data **B**.
 - He uses the Cam Loader to create the script file **C** for Cam Loader control without user interface.
2. The mechanical/automation engineer delivers the prepared system to the user.
3. The user uses the directories prepared by the mechanical/automation engineer as a basis to produce new or modified products on the machine:
 - He enters new/changed product data **B** manually into the corresponding axes subdirectories, e.g. via remote maintenance.
 - If necessary, he extends the script file **C** prepared by the mechanical/automation engineer.
4. The user changes the product or transfers changed product data, e.g. via an HMI connected to the IPC:
 - The HMI is used to start the Cam Loader in batch mode which creates the LCx file in accordance with the script file data and transfers it to the target system **D**.
 - The data is transmitted online. In this way, the target system need not always be restarted.
5. The user can repeat steps 3 and 4 as often as required, e.g. to optimise the production process.

Global Drive Cam Loader

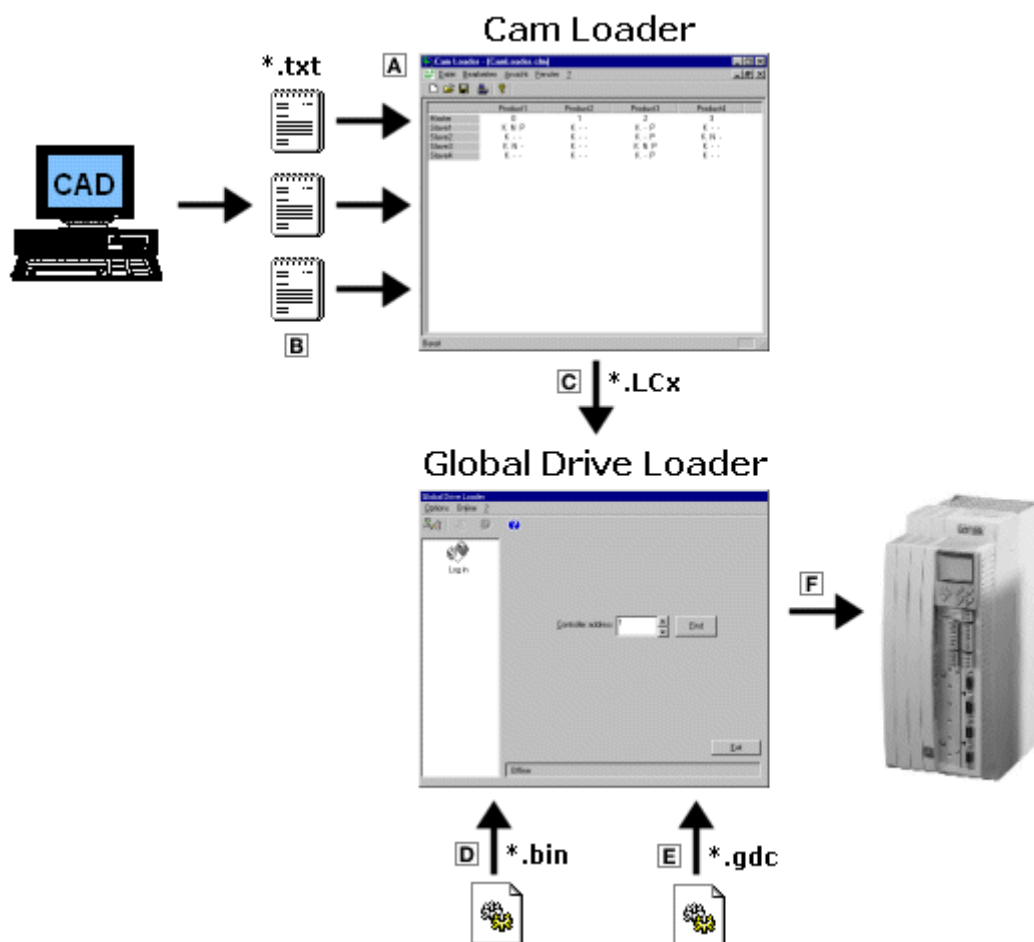
Introduction

Cam Loader applications

4.1.3 Commissioning of production machinery





For the commissioning of production machinery, you have to transfer the motion profiles, cam tracks and position markers as well as the user program and the parameter sets to the target system.

- ▶ In this case, the Cam Loader is only used to create the LCx files.
- ▶ The Global Drive Loader is used to transfer the drive data to the target system:



Basic proceeding:

1. Use the user interface of the Cam Loader **A** and create a new Cam Loader project. The axes subdirectories for existing and future product data (motion profiles, cam tracks and position markers) are created automatically.
2. The Cam Loader assigns the product data **B**, which has e.g. been created by means of a CAD system and is available as tables of points according to VDI directive VDI 2143, to the corresponding axes/products.
3. Before the data is downloaded by means of the Global Drive Loader, the Cam Loader is started without user interface by means of the script file to create the LCx file or update it if the product data has changed.
 - The required script file can be automatically created by the Cam Loader.

4. The LCx file , the DDS file  including the compiled user program and the GDC file  including the parameter sets for the corresponding target system are transferred to the Global Drive Loader.
5. After this, the drive data  is downloaded by the Global Drive Loader.
 - The Global Drive Loader can also be started by means of a script file. The entire process can thus be automated. (See the documentation for the Global Drive Loader.)

**Note!**

The latest Global Drive Loader version only supports 9300 Servo PLCs and ECSs. Support for the 9300 servo cam profiler follows later.

4.2 Creating/preparing import data

For each axis and product number you need an ASCII file including the data of the motion profile, cam tracks (option) and position markers (option).

**Tip!**

The motion profiles and position data are described as tables of points according to VDI guideline VDI 2143 "Motion rules for cam mechanisms".

- The required files can be created by means of a CAD system, the Lenze Cam Designer or similar software products.
- Detailed information about the data formats can be found in the following subsections.

**Note!**

The 9300 EK controller (9300 servo cam profiler) does not support cam tracks and position markers!

Global Drive Cam Loader

Introduction

Creating/preparing import data

4.2.1 Data format of motion profile data

For data import with the Cam Loader, the motion profile data must be available as an ASCII file with the ending *.txt.

- ▶ Each line contains the x and y position of a point.
- ▶ Comma and point are allowed as decimal symbols.
- ▶ Between the two position data there may only be one or several separators (spaces or tab characters).
- ▶ After the two position data you can add a comment after at least one separator and two slashes ("/") (option).
- ▶ Space lines between the position data are allowed.
- ▶ The points must be entered in ascending order of the x positions.
- ▶ Each file must contain at least two interpolation points.



Note!

If a syntax error occurs during the data import the number of the line in which the syntax error has occurred will be indicated in the optional error message!

Example:

```
10.0 20.0 // point 1
20.0 30.0 // point 2
33.3 44.4 // point 3
55.5 66.6 // point 4
77.7 88.8 // point 5
```



Note!

Servo PLC and ECSxA... allow for specifying an acceleration profile.

- If a profile is specified, then this acceleration profile will be used.
- If no profile is specified, the second derivative is formed from the curve for the acceleration profile.

Example:

The 3rd column contains the acceleration values in Nm referenced to the motor.

```
10.0 20.0 1.0 // point 1
20.0 30.0 2.5 // point 2
33.3 44.4 1.0 // point 3
55.5 66.6 1.0 // point 4
77.7 88.8 0.0 // point 5
```

4.2.2 Data format of cam track data

For data import with the Cam Loader, the cam track data must be available as an ASCII file with the ending *.txt.

- ▶ For each product number, you can define max. three cam tracks with 4 cams each.
- ▶ The cam track data are to be entered as follows:
 - Cam type
 - Cam reference
 - Start/stop value of cam 1
 - Start/stop value of cam 2
 - Start/stop value of cam 3
 - Start/stop value of cam 4

General notes

- ▶ After the cam track data you can add a comment after at least one separator (space or tab character) and two slashes ("/") (option).
- ▶ Space lines between the entries are allowed.



Note!

If a syntax error occurs during the data import the number of the line in which the syntax error has occurred will be indicated in the optional error message!

The 9300 EK controller (9300 servo cam profiler) does not support cam tracks!

Global Drive Cam Loader

Introduction

Creating/preparing import data

Cam type

The cam type is defined through the following numbers:

Entry	Cam type
1	Position cam in positive effective direction <ul style="list-style-type: none"> • Switch on and switch off point are defined by positions. • The cam switches if the direction of the axis is positive (positive speed).
2	Position cam in negative effective direction <ul style="list-style-type: none"> • Switch on and switch off point are defined by positions. • The cam switches if the direction of the axis is negative (negative speed).
3	Position cam with bipolar effective direction <ul style="list-style-type: none"> • Switch on and switch off point are defined by positions. • The cam switches in positive and negative direction of the axis.
11	Time-based cam in positive effective direction <ul style="list-style-type: none"> • The cam switches on at the switch on point if the direction of the axis is positive (positive speed). • After the selected time, the cam switches off.
12	Time-based cam in negative effective direction <ul style="list-style-type: none"> • The cam switches on at the switch on point if the direction of the axis is negative (negative speed). • After the selected time, the cam switches off.

Cam reference

The cam controller can either refer to the X axis or to the Y axis.

Entry	Cam reference
0	X axis
1	Y axis

Start and stop values of the cams

Each line contains the start and stop value of a cam.

- ▶ For time-based cams, enter the ON-time in [ms] of the cam instead of the stop value.
- ▶ The cams must be entered in ascending order of the start values.
- ▶ The start and stop value of free cams is "0.0". They have to be listed at the end of the structure.

Example:

```

12 // Cam track 1: Time-based cam in positive effective direction
0 // Reference: X axis

    10.0 20.0 // cam 1
    20.0 30.0 // cam 2
100.0 40.0 // cam 3
    0.0 0.0 // cam not assigned

2 // Cam track 2: Position cam in negative effective direction
1 // Reference: Y axis

    11.1 22.2 // cam 1
    33.3 44.4 // cam 2
    55.5 66.6 // cam 3
    77.7 88.8 // cam 4

1 // Cam track 3: Position cam in positive effective direction
0 // Reference: X axis

    10.0 20.0 // cam 1
    20.0 30.0 // cam 2
    0.0 0.0 // cam not assigned
    0.0 0.0 // cam not assigned

```

Global Drive Cam Loader

Introduction

Creating/preparing import data

4.2.3 Data format of position markers

For data import with the Cam Loader, the position marker data must be available as an ASCII file with the ending *.txt.

- ▶ Each line contains one position (X and Y value).
- ▶ The position data can be entered in any order.
- ▶ After the X and Y position you can add a comment after at least one separator (space or tab character) and two slashes ("/") (option).
- ▶ Space lines between the position data are allowed.



Note!

If a syntax error occurs during the data import the number of the line in which the syntax error has occurred will be indicated in the optional error message!

The 9300 EK controller (9300 servo cam profiler) does not support position markers!

Example:

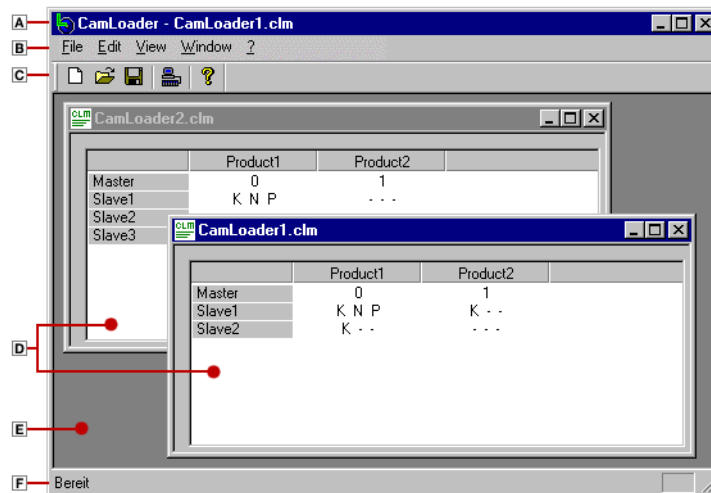
```
10.0 20.0 // position 1
75.5 66.6 // position 2
63.0 30.0 // position 3
33.3 44.4 // position 4
```

5 User interface



Go to the *Start menu* and select **Programs→Lenze→Global Drive Cam Loader 1.1→Global Drive Cam Loader** to start the Cam Loader with user interface.

The user interface contains the following control and function elements:



A [Title bar](#)

C [Toolbar](#)

E [Workspace](#)

B [Menu bar](#)

D [Document window \(worksheet\)](#)

F [Status bar](#)



Tip!

As an alternative, the Cam Loader can be controlled by means of a script file to download data automatically to several target systems without additional user entries. Information about this can be found in chapter [Control via script files](#). (44)

5.1 Using the direct help

The Cam Loader includes a so-called direct help which can be used to display information about specific areas of the user interface.



Select the command **Help→Direct help** and click the area about which you want to obtain more detailed information.

Global Drive Cam Loader

User interface

Language selection

5.2 Language selection

You can always select another language for the menu, dialog and help texts of the Cam Loader.

- ▶ The available languages depend on the language files that have been installed together with the Cam Loader.









How to select another language...

1. Select the command **View→Select language**.
2. Go to the *Language configuration* dialog box and select the desired language.
3. Click **OK** to confirm your selection and close the dialog box.

5.3 Title bar

The *title bar* at the top of the application window shows the **program icon** and the **program name** on the left and the **window icons** on the right.

- ▶ With a click on the **Window icons**   you can change the representation of the application window as follows:
 - Icon in the *task bar* ()
 - Full screen ()
 - Window size ()
- ▶ A click on the **program icon** opens the **system menu** which also includes commands for positioning and changing the size of the application window.
- ▶ A click on the **window icon**  or a double-click on the **program icon** closes the Cam Loader.

5.4 Menu bar

The menu commands of the Cam Loader can be accessed via the *menu bar*.

- ▶ A click on an item of the main menu opens the corresponding menu and lists the menu items contained in it.
- ▶ Click a menu item to execute the corresponding function.
 - Menu items which are displayed in light gray are currently deactivated because the execution of the corresponding function would not make any sense in the current program state.








Tip!

Many frequently used functions can be executed faster by means of the [Toolbar icons](#). (21)

5.5 Toolbar

Via the icons of the *toolbar* you can directly execute some of the most frequently used menu commands without making a detour via the [Menu bar](#).

- ▶ Simply click an icon to activate the corresponding command.

Icon	Function
	Creating a new project
	Opening an existing project
	Saving the current project
	Changing between offline and online mode
	Indicating information about the program



Tip!

If you position the mouse pointer for a short time over an icon, a "tooltip" will be indicated with information about the corresponding function. More information will be indicated in the [Status bar](#).

5.6 Workspace

The document windows (worksheets) are displayed in the workspace.

- ▶ When the Cam Loader is started, the workspace is blank because there are no open projects.

Global Drive Cam Loader








User interface

Document window (worksheet)

5.7 Document window (worksheet)

If you open a project the corresponding *worksheet* will be indicated in a so-called *document window* in the Cam Loader [Workspace](#).

By default, the *document window* is displayed on a full screen, i.e. the *document window* fills the whole *workspace* of the Cam Loader.

- ▶ With a click on the **window icons**    at the top right of the *document window* you can change the representation of the *document window* as follows:
 - Icon within the *workspace* ()
 - Full screen ()
 - Window size ()
- ▶ A click on the **program icon** opens the **system menu** which also includes commands for positioning and changing the size of the *document window*.
- ▶ A click on the **window icon**  or a double-click on the **program icon** closes the *document window*.
- ▶ Use the key combination **<Strg>+<F6>** to jump from one *document window* to the next *document window*.

"Window" menu

The **Window** menu contains the following commands for the arrangement of the *document window*:

Command	Function
New window	Opens a new window with the same contents as the active window. In this way, it is possible to display different parts or views of a worksheet simultaneously. <ul style="list-style-type: none"> • The new window will be automatically the active window and will be indicated above all other open windows. • If the contents of an open window is changed the contents of all other open windows of the project changes as well.
Cascade	Cascades all windows in the workspace.
Horizontal	Arranges all windows in the workspace horizontally.
Arrange icons	Arranges all windows reduced to an icon at the bottom of the workspace. <ul style="list-style-type: none"> • If a window opens in this section, it may happen that one or all icons are hidden because they are under the window.
1, 2, 3...	All open windows are listed at the end of the Window menu. A click on an entry activates the corresponding window (and places it on top of the desktop). <ul style="list-style-type: none"> • The active window is indicated by a hook in front of the entry.

5.8 Status bar

The program status is indicated in the *status bar*.



Tip!

If you position the mouse pointer over an icon in the [Toolbar](#) or a menu command more information about the corresponding function will be indicated in the *status bar*.

6 Operation

After the first start of the Cam Loader, the user interface is displayed with an empty workspace.

- ▶ Now you can create a new project (worksheet) or open an existing project.



Tip!

In the installation directory of the Cam Loader you can find example projects which can be used to make yourself familiar with the operation of the Cam Loader.

What do you want to do?


- ▶ [Creating a new project](#)
- ▶ [Opening an existing project](#) (📖 29)

6.1 Creating a new project

New projects are created by means of a wizard which issues a number of queries including the file name and directory for the new project as well as the settings for the master, a slave and a product.



How to create a new project...

Go to the *toolbar* and click the  icon or select **File**→**New** to create a new project by means of the wizard:



Detailed information about the individual steps can be found in the following sub-sections.

After the basic settings have been selected by means of the wizard, you can add more slaves and products to your project if required for your drive application.

6.1.1 Step 1: Defining the file name and directory for a project



Tip!

We recommend to create a separate project directory for every new project. The Cam Loader creates a subdirectory for each slave where the corresponding drive data is stored.

- All path names within a project are relative and refer to the project directory.
- If you want to transfer a project to another PC, simply copy the project directory to the corresponding PC.

Global Drive Cam Loader

Operation

Creating a new project



How to define the file name and directory for a new project...

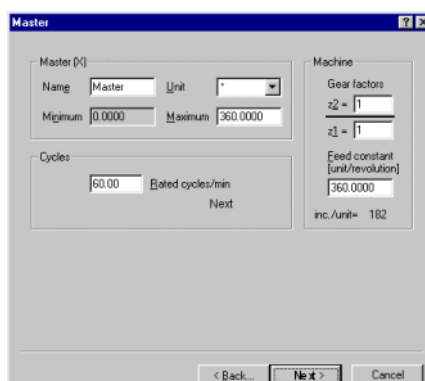
1. Go to the *New project* dialog box and click the **Project save as** button to open the *Save as* dialog box.
2. Go to the *Save as* dialog box and select the directory in which you want to store the new project.
3. Go to the **File name** input field and enter a name for the new project.
4. Click **OK** to confirm the settings for the new project and close the *Save as* dialog box.
5. Go to the *New project* dialog box and click **Next** to proceed with the next step.

6.1.2 Step 2: Defining the properties of the master



How to define the properties of the master...

1. Go to the *Master* dialog box and select the properties of the master.




- The **Name** of the master is indicated on your worksheet.
 - The **Cycles** are the maximum number of operating cycles per minute.
2. Click **Next** to proceed with the next step.

6.1.3 Step 3: Defining the properties of the slave



How to define the properties of the slave...

1. Go to the *Slave* dialog box and select the properties of the slave.

- The **Name** of the slave is indicated on your worksheet. It is also used as name for the LCx file. The Cam Loader creates a subdirectory with the same name in the project directory. The subdirectory is used to store the LCx file/script file and, in turn, contains a subdirectory called "Import data" which is used in the default setting to store the import files.
 - When selecting the **Type** "9300 EK (9300 servo cam profiler)" you can optionally indicate the corresponding **GDC file**. The **Gear factors** and the **Feed constant** will then be automatically read from this file.
 - If you have an online connection you can use the  button after the **Drive** input field to assign an axis to the slave.
 - If the selection **LC download without import of data** is active only the LCx file that already exists in the LC path will be downloaded. There is no compilation.
 - The selections under **Absolute data model** and **Curves** have a direct influence on the maximum number of points. If you need more points for the table of points deactivate the selection **Absolute data model** and use the relative data model or reduce the value under **Curves**.
 - The maximum number of **Curves** depends on the selected controller type.
2. Click **Next** to proceed with the next step.

Global Drive Cam Loader

Operation

Creating a new project

6.1.4 Step 4: Defining the product properties



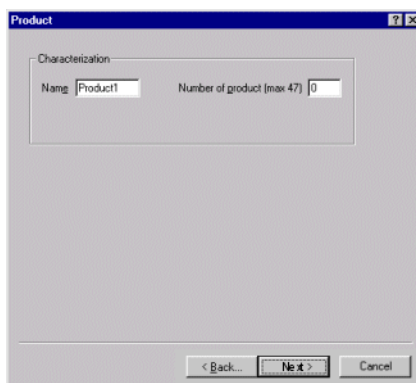
Tip!

In the following text, the term "Product" is used for cam or motion profiles because product-dependent sequences of motion can be achieved through different cam profiles.



Defining the product properties...

1. Go to the *Product* dialog box and select the product properties:



- The **name** is only indicated for a better overview within the Cam Loader, otherwise it is not of importance.
 - The maximum **product number** depends on the type of target system selected for the axis.
 - Later on, the user can use the **product number** (cam profile number) to activate the corresponding motion profile in the axis.
 - "0" is assigned to the first product data set.
2. Click **Finish** to complete the creation of the new project.

After the basic settings have been selected by means of the wizard, the master, the slave and the product are indicated on the *worksheet*:

	Product1
Master	0
Slave1	...

Next steps

Now you can assign the files for the slave to the product and add more slaves and products to your worksheet, if required.

- ▶ [Editing settings on the worksheet](#) (30)

6.2 Opening an existing project




Tip!

- It is possible to open several Cam Loader projects (*worksheets*) simultaneously. The commands for the arrangement of the individual *worksheets* can be found in the "Window" menu.
- With a click on the entries **1...4** in the **File** menu you can open one of the four projects edited last.



How to open an existing project...

1. Go to the *Toolbar* and click on the  icon or select **File→Open**.
2. Go to the *Open* dialog box and select the corresponding project file (*.clm).
3. Click **Open**.
 - After this, the project worksheet will be displayed in the workspace.

Next steps

- ▶ [Editing settings on the worksheet](#) (📖 30)

Global Drive Cam Loader

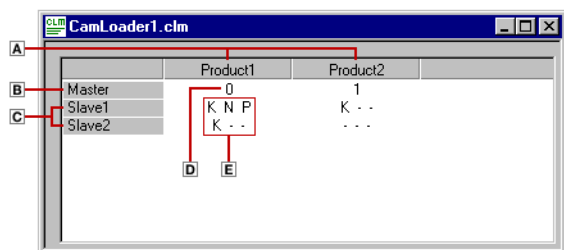
Operation

Editing settings on the worksheet

6.3 Editing settings on the worksheet

The *worksheet* consists of a table including all axes and products of the plant or machine project.

Each line of the table represents an axis and each column a product:



	Product1	Product2
Master	0	1
Slave1	K N P	K - -
Slave2	K - -	- - -

A Products
B Master
C Slaves
D Product number
E Import data for slave/product



Tip!

- If you want to edit a setting on your *worksheet* simply click the corresponding field in the table.
- In the *Context menu* (right mouse key) and the **Edit** menu, you can find further commands, e.g. to add slaves and products to your project or remove them from it.
- The commands of the Window menu can be used to arrange the worksheets in the workspace.

[\(22\) Document window \(worksheet\)](#)

Master

The topmost line in the table is the master. It indicates the product number for each product (the product number does not refer to the master):



	Product1	Product2	Product3	Product4
Master	0	1	2	3
Slave1	K N P	K - -	K - P	K - -
Slave2	K - -	K - -	K - P	K N -
Slave3	K N -	K N -	K N P	K - -
Slave4	K - -	K - -	K - P	K - -

- ▶ A double-click on the *Name field* of the master B opens the *Properties* dialog box for the master.
- ▶ A double-click on a *Product number field* D opens the *Properties* dialog box for the corresponding product.

Slaves

The following table lines represent the slaves:

	Product1	Product2	Product3	Product4
Master	0	1	2	3
Slave1	K N P	K - -	K - P	K - -
Slave2	K - -	K - -	K - P	K N -
Slave3	K N -	K N -	K N P	K - -
Slave4	K - -	K - -	K - P	K - -

- ▶ A double-click on the *Name field* of a slave  opens the *Properties* dialog box for the corresponding slave.
- ▶ A double-click on an *Import data field*  opens the *Import data* dialog box for the corresponding slave and the corresponding product.

Assignment of the import data

At the crossing point of a slave and a product the assigned import data are represented by letters.

- ▶ In the below figure, the edged *import data field* contains the import data assigned to "Slave3" and product number 2:

	Product1	Product2	Product3	Product4
Master	0	1	2	3
Slave1	K N P	K - -	K - P	K - -
Slave2	Download	Download	Download	Download
Slave3	K N -	K N -	K N P	K - -
Slave4	K - -	K - -	K - P	K - -

- ▶ Meaning of the letters for the assigned import data:
K = cam profile (motion profiles), **N** = cam tracks, **P** = position markers
- ▶ Downloading means:
An existing LCx file is downloaded to the target system. There is no compilation.

Global Drive Cam Loader

Operation

Editing settings on the worksheet

6.3.1 Adding a slave

New slaves are added at the end of the list. You can enter a symbolic name for the new slave which will be indicated on your *worksheet*.

- ▶ The name of the slave is also used as name for the LCx file.
- ▶ The Cam Loader creates a subdirectory with the same name in the project directory. The subdirectory is used to store the LCx file/script file and, in turn, contains a subdirectory called "Import data" which is used in the default setting to store the import files.



How to add a slave to your worksheet...

1. Select **Edit**→**Add slave**.
2. Go to the *Project settings* dialog box and enter the name and the properties of the slave.
 - The maximum product number determines the minimum number of **curves**. The maximally possible entry depends on the target system.

▶ [How to define the properties of the slave...](#) (📄 27)
3. Click **OK** to confirm the settings and close the dialog box.

6.3.2 Selecting the properties of a slave

The properties of a slave can always be changed.



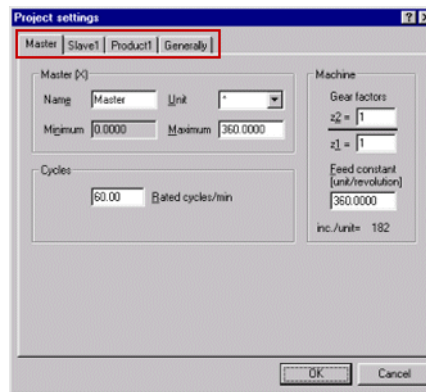
How to change the properties of a slave...

1. Double-click the grey field with the name of the slave whose properties you want to change on your *worksheet*.
2. Go to the *Project settings* dialog box and enter the new settings.
 - ▶ [How to define the properties of the slave...](#) (📄 27)
3. Click **OK** to confirm the settings and close the dialog box.

**Tip!**

If you want to change the settings of several axes/products you can also use the command **Edit→Project settings....**

In the *Project settings* dialog box that appears you can quickly change between the different axes/products by clicking the corresponding tabs:



6.3.3 Adding a product

**How to add a product to your worksheet...**

1. Select **Edit→Add product**.
2. Go to the *Project settings* dialog box and enter the **name** and the **product number** of the new product.
 - The **product name** is indicated on your *worksheet*.
 - The **product number** is indicated in the master line of your *worksheet*. Each product number may only be assigned once.
 - The maximum **product number** determines the minimum number of curves. The maximally possible entry depends on the target system.
 - Later on, the user can use the **product number** (cam profile number) to activate the corresponding motion profile in the axis.

▶ [Defining the product properties...](#) (📖 28)

3. Click **OK** to confirm the settings and close the dialog box.

Global Drive Cam Loader

Operation

Editing settings on the worksheet

6.3.4 Selecting the product properties

The product properties can always be changed.



How to change the product properties...

1. Double-click the field with the product number of the product whose properties you want to change on your worksheet.
2. Go to the *Project settings* dialog box and enter the new settings.
 - ▶ [Defining the product properties...](#) (📖 28)
3. Click **OK** to confirm the settings and close the dialog box.

6.3.5 Defining the import data for a slave/product



Tip!

Detailed information about the file format of the import data can be found in chapter "[Creating/preparing import data](#)". (13)



How to assign import data to a slave/product...

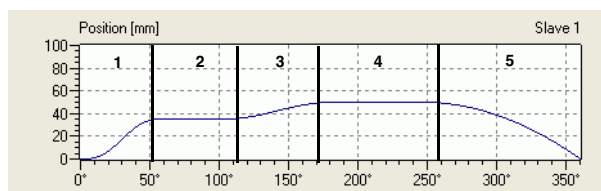
1. Double-click the *import data field* at the crossing point of slave and product on your *worksheet*.

Example: *Import data field* for Slave3 and Product2:

	Product1	Product2	Product3	Product4
Master	0	1	2	3
Slave1	K N P	K - -	K - P	K - -
Slave2	Download	Download	Download	Download
Slave3	K N -	K N -	K N P	K - -
Slave4	K - -	K - -	K - P	K - -

2. Go to the *Import data* dialog box and enter the files (*.txt) containing the import data:


- The active selection **Segmented curve** can feature a curve with up to five curve segments.



Global Drive Cam Loader

Operation

Editing settings on the worksheet

- A click on the  icon opens a dialog box in which you can select the corresponding import data from your directories.
 - With the "9300 EK (9300 servo cam profiler)" the Cams and Positions input fields are deactivated because cam tracks and position markers are not supported by the 9300 servo cam profiler.
 - If you want to cancel an assignment simply delete the text in the corresponding input field.
3. Click **OK** to confirm the settings and close the dialog box.

6.3.6 Creating LCx files

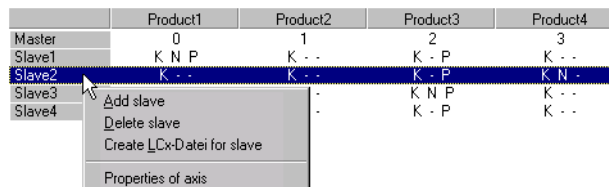
Optionally, you can create the LCx files for one or several slaves simultaneously.

- ▶ Each LCx file is assigned to a drive axis. The LCx file contains the motion profiles of the corresponding axis and other axis-specific data. With the 9300 servo PLC and ECS, the LCx file also includes the defined cam tracks and position markers.
- ▶ The Cam Loader stores the created LCx files in the subdirectory of the corresponding slaves.
- ▶ For "9300 EK (9300 servo cam profiler)" target systems, Cam Loader creates LC7 files, for "9300 servo PLC" and "ECS" target systems LC9 files.



How to create an LCx file for a slave...

1. Position the mouse pointer over the *name field* of the slave for which you want to create an LCx file and open the *context menu* with a click on the right mouse key:

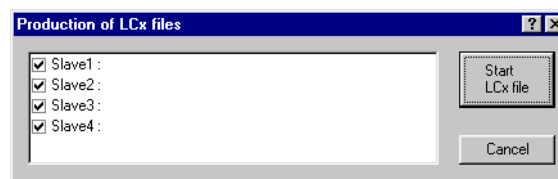


2. Select the command **Create LCx file for slave** from the *context menu*.



How to create LCx files for several slaves simultaneously...

1. Select **File→Create LCx file...**
2. Go to the *Production of LCx files* dialog box and select the slaves for which the LCx files shall be created.
 - In the default setting, all slaves are selected:



3. Click the **Start LCx file** button to create the LCx files for the selected slaves and close the dialog box.

Global Drive Cam Loader

Operation

Editing settings on the worksheet

6.3.7 Deleting a product



Note!

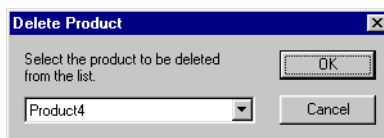
This function only deletes a product from the project/worksheet. The import data assigned to the product are **not** deleted!

Deleting a product cannot be undone!



How to delete a product...

1. Select **Edit**→**Delete product...**
2. Go to the *Delete product* dialog box and select the product to be deleted from the project:



3. Click **OK** to delete the selected product and close the dialog box.

6.3.8 Deleting a slave



Note!

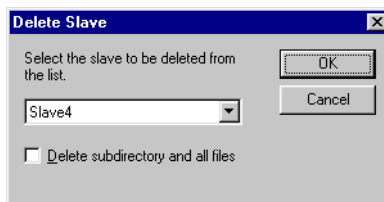
This function only deletes a slave from the project/worksheet. The corresponding LCx file is **not** deleted!

Deleting a slave cannot be undone!



How to delete a slave...

1. Select **Edit**→**Delete slave...**
2. Go to the *Delete slave* dialog box and select the slave to be deleted from the project:



3. Click **OK** to delete the selected slave and close the dialog box.

6.4 Connection with the OPC server

The Lenze DriveServer is used for communication between Cam Loader and target system and LCx file transfer.

- The DriveServer provides easy integration of drives into open automation structures based on OPC (*OLE for Process Control*).
- A specially adapted variant of the DriveServer and the bus server for the system bus (CAN) is part of the Cam Loader installation package.



Select **File**→**Connect to OPC server** to connect the Cam Loader to the OPC server or cancel the connection.
A hook in front of the menu command indicates the connection with the OPC server.

6.5 Downloading the drive data

If connection with the OPC server has been established it is possible to transfer the drive data for **several** slaves in one step. ▶ [Connection with the OPC server](#)

- ▶ The configuration files (LCx files) for the selected axes are created first.
- ▶ If you have an online connection with the corresponding target system the LCx file will be directly transferred to the target system.



Note!

With the 9300 servo PLC, the LC9 file can only be downloaded if the target system includes a DDS project based on **Template Cam**.

Global Drive Cam Loader

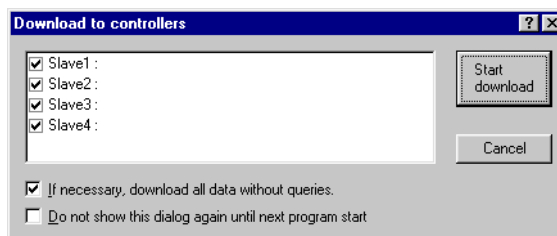
Operation

Downloading the drive data



How to download the drive data...

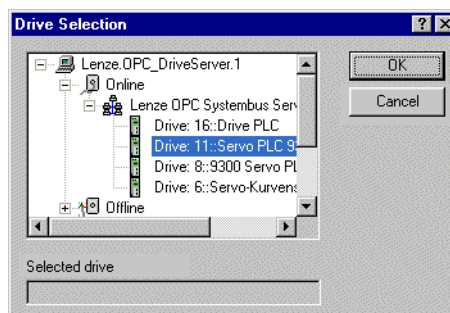
1. Select **File**→**Download of multiple slaves...**
 - This command can only be executed if the Cam Loader is connected to the OPC server.
2. Go to the *Download to controllers* dialog box and select the slaves to be downloaded:



- If the checkbox **If necessary, download all data without queries** is activated the data will be downloaded without further queries.
 - If the checkbox **Do not show this dialog again until next program start** is activated this dialog will not be indicated again until the next program start. This can be useful for the commissioning of standard systems or in case of frequent downloads.
3. Click the **Start download** button to start the data transfer.

Note: If you have not yet assigned a drive to one of the slaves the *Drive selection* dialog box opens automatically.

- Double-click the drive to be assigned to the slave in the DriveServer tree:



- Click **OK** to confirm your selection and repeat the assignment for other slaves, if necessary.

6.6 Saving a project



Note!

If you open several Cam Loader projects simultaneously this function refers to the project in the active window.



Click the  icon or select **File→Save** to save the project.



Tip!

Save your project at regular intervals to protect your data against power failures or system problems.

If you want to create a backup project on another data carrier or in another directory use the command **File→Save as...** instead.

▶ [Saving a project under another name](#)

6.7 Saving a project under another name



Note!

If you open several Cam Loader projects simultaneously this function refers to the project in the active window.



How to save an open project under another name...

1. Select **File→Save as...** to open the *Save as* dialog box.
2. Go to the **Save as** list field and select the directory in which you want to store the project.
3. Go to the **Name** input field and enter a name for the new project.
4. Click **OK** to save the project under the specified name in the selected directory and close the dialog box.
 - If you select the command **File→Save** the project will be saved with the new settings.

Global Drive Cam Loader

Operation

Creating a template for a script file



Tip!

This way you can create a new project or a backup project on another data carrier or in a directory other than the project directory on the basis of the current project.

6.8 Creating a template for a script file

The Cam Loader can automatically create a script file for an open project which can be used to start the Cam Loader without user interface, e.g. on an IPC.

- Detailed information about the use of script files for Cam Loader control can be found in chapter "[Control via script files](#)". (44)



Select the command **File→Create script files** to create a script file for the current project.



Note!

The script file can be found under the project name in the corresponding project directory. It has the ending ".cmd".

- In addition, one script file each will be created for each axis and stored under the name of the axis in the corresponding axis subdirectory.

6.9 Closing a project



Note!

If you open several Cam Loader projects simultaneously this function refers to the project in the active window.



Select **File→Close** to close the open project.

6.10 Exiting the Cam Loader



Note!

If you have not saved the changes made in one or several projects you will be asked if you want to save them before exiting the Cam Loader.



Select **File→Exit** or click the Window icon **X** in the Title bar to exit Cam Loader.

Global Drive Cam Loader

Control via script files

Creating a script file

7 Control via script files

When configuring production machinery, it is useful to control the conversion and download of the cam profiler data by means of batch files. For this purpose, the Cam Loader can be controlled by means of a script file without the need of additional data input.

- ▶ For this, the Cam Loader is started with additional program parameters via the command line.
- ▶ As an option, the processing results of the script file can be listed in a log file.

7.1 Creating a script file

The Cam Loader can automatically create a script file for an open project which can be used to start the Cam Loader without user interface, e.g. on an IPC.



Select the command **File→Create script files** to create a script file for the current project.

- ▶ The script file can be found under the project name in the corresponding project directory. It has the ending ".cmd".
 - The script file contains all project axes, i.e. for a complete download you only have to start the Cam Loader with the script file.
- ▶ In addition, one script file each will be created for each axis and stored under the name of the axis in the corresponding axis subdirectory.
 - The script files can be used to carry out script-controlled downloads to the individual axes.



Tip!

As an alternative, script files can be created with a traditional text editor. Information about the script files and an example can be found in the next chapter [Script files](#). (45)

7.2 Script files

Script files are divided into sections. Different keys can be entered in the sections, therefore they are very similar to typical Windows INI files.

- ▶ Sections are put into square brackets. The following lines list the keys for a specific section.
- ▶ A key consists of a key name followed by an equal sign and a key value.
- ▶ Comments can be added, the comment must, however, be separated from the key value by a semicolon.
- ▶ It is not possible to enter more than one key per line.



Note!

If required, it is possible to edit the script files with any ASCII text editor (e.g. Notepad).

Example of a script file

```
[CamLoader]
NumberOfSlaves=3
NumberOfProducts=2
MasterName=Master
MasterUnit=°
MasterMinimum=0.0000
MasterMaximum=360.0000
MasterGear1=5.00
MasterGear2=1.00
MasterFeed=360.0000
MasterIncrement=65536.00
MasterCycles=60.00
[Product001]
Name=Product2
Number=2
ID=2
[Product002]
Name=Product3
Number=1
ID=3
[Slave001]
Name=Slave1
Unit=mm
Minimum=0.0000
Maximum=1000.0000
Gear1=10.00
Gear2=2.00
Feed=180.0000
Increment=65536.00
NumberOfCurves=2
Points=50
DataModel=1
LCDownload=0
DriveType=1
DeviceName=
```

Global Drive Cam Loader

Control via script files

Script files

```
ParameterSetFile=.\Slave1\LC7_beispiel.GDC
LC-Path=.\Slave1
Segmented002=1
PathCurve002=.\Slave1\Importdata\Segment1.txt
PathCurve_B002=.\Slave1\Importdata\Segment2.txt
PathCurve_C002=.\Slave1\Importdata\Segment3.txt
PathCurve_D002=.\Slave1\Importdata\Segment4.txt
PathCurve_E002=.\Slave1\Importdata\Segment5.txt
PathPosition002=.\Slave1\Importdata\Pos1.txt
Segmented003=0
[Slave002]
Name=Slave2
Unit=mm
Minimum=0.0000
Maximum=0.0000
Gear1=1.00
Gear2=1.00
Feed=360.0000
Increment=65536.00
NumberOfCurves=2
Points=50
DataModel=0
LCDownload=1
DriveType=0
DeviceName=
ParameterSetFile=
LC-Path=.\Slave2
Segmented002=0
Segmented003=0
[Slave003]
Name=Slave3
Unit=mm
Minimum=0.0000
Maximum=0.0000
Gear1=1.00
Gear2=1.00
Feed=360.0000
Increment=65536.00
NumberOfCurves=2
Points=50
DataModel=0
LCDownload=0
DriveType=0
DeviceName=
ParameterSetFile=
LC-Path=.\Slave3
Segmented002=0
Segmented003=0
PathCurve003=.\Slave3\Importdata\LineRel500.txt
PathPosition003=.\Slave3\Importdata\Point1.txt
```

7.2.1 Master settings

Section [CamLoader]

Key	Parameter
NumberOfSlaves	Number of slaves
NumberOfProducts	Number of products (motion profiles)
MasterName	Name of the master
MasterUnit	Unit of the master
MasterMinimum	Minimum of the master
MasterMaximum	Maximum of the master
MasterGear1	Gear factor of the master (numerator)
MasterGear2	Gear factor of the master (denominator)
MasterFeed	Feed constant of the master
MasterIncrement	Increments of the master
MasterCycles	Cycles of the master [cycles/min]

7.2.2 Product settings

Section [ProductXXX]

Key	Parameter
Name	Name of the product
Number	Product number
ID	Product ID

7.2.3 Slave settings

Section [SlaveXXX]

Key	Parameter
Name	Name of the slave
Unit	Unit of the slave
Minimum	Minimum of the slave
Maximum	Maximum of the slave
Gear1	Gear factor of the slave (numerator)
Gear2	Gear factor of the slave (denominator)
Feed	Feed constant of the slave
Increment	Increments of the slave
NumberOfCurves	Number of motion profiles (products)
Points	Number of points per motion profile
DataModel	Data model 0 = Relative data model 1 = Absolute data model

Global Drive Cam Loader

Control via script files

Syntax of the command line start

Key	Parameter
LCDownload	LC download 0 = no 1 = yes (no compilation, only LC download)
DriveType	Target system 0 = 9300 servo PLC / ECS 1 = 9300 EK (9300 servo cam profiler)
DeviceName	Name of the target system in the name area of the DriveServer
ParameterSetFile	Parameter file only with 9300 EK (9300 servo cam profiler)
LC-Path	Directory for the LCx file
PathCurveXXX	ASCII file containing the motion profiles for product XXX
PathPositionXXX	ASCII file containing the position markers for product XXX
PathContactorXXX	ASCII file containing the cam tracks for product XXX
SegmentedXXX	Segmentation 0 = no 1 = yes
PathCurve_B002	ASCII file with the motion profiles for product XXX (SegmentedXXX=1)
PathCurve_C002	ASCII file with the motion profiles for product XXX (SegmentedXXX=1)
PathCurve_D002	ASCII file with the motion profiles for product XXX (SegmentedXXX=1)
PathCurve_E002	ASCII file with the motion profiles for product XXX (SegmentedXXX=1)

7.3 Syntax of the command line start

Use the following syntax to start the Cam Loader in batch mode:

```
CamLoader.exe /batch script file [log file]
```

- ▶ The **/batch** parameter ensures the script-controlled execution of the program functions.
- ▶ The **script file** parameter indicates the script file.
 - It is possible to use absolute and relative path names. A relative path always refers to the current directory.
- ▶ The entry of the **log file** parameter is optional. It contains the name of the log file in which all Cam Loader activities and error messages are recorded.
 - If you do not enter a path for the log file the log file will be saved in the same directory as the script file.
 - If you do not enter the **log file** parameter Cam Loader does not create a log file.

Example:

```
CamLoader.exe /batch MyScript.cmd MyLogfile.txt
```

7.4 Log files

Log files list all important events for documentation and diagnostics purposes:

- ▶ Program start
- ▶ Connection with the OPC server
- ▶ Information about the creation of the LCx file
- ▶ Download information

Example of a log file

```
CamLoader - Log File
Monday, November 03, 2003, 09:48:32

Script file: E:\Programs\Lenze\CamLoader_0_2\Project_1\Test1_CamLoader_93EK_93PLC.cmd
-----

Script file read successfully.
Connected to OPC server.
Slave1_93EK - Creation of the LC7 file.
Slave1_93EK - Download start.
Slave2_93PLC - Creation of the LC9 file.
Slave2_93PLC - Download start.
Slave2_93PLC - Download OK.
```

Global Drive Cam Loader

Appendix

Error numbers, causes & remedies

8 Appendix

8.1 Error numbers, causes & remedies

Error number	Cause	Remedy
Script file errors		
D000h	An error occurred during opening the script file.	Check path and/or file name.
D001h	An error occurred in the script file data.	Save project again to create a new script file or correct script file manually with a text editor (the faulty key is indicated in the error message).
Communication and download errors		
D100h	Error during the start of the "OPC Ctl" component. <ul style="list-style-type: none"> Component has not been installed or has not been registered correctly. 	Re-install Cam Loader.
D101h	No connection with the OPC server.	Check if the OPC server has been installed correctly. Re-install Cam Loader.
D102h	OPC server is not in status "Running".	Re-start PC.
D103h	Error during creating an OPC item.	Re-install Cam Loader.
D104h	Error during download.	The error message contains causes and information about troubleshooting.
D105h	Error during connection with the OPC server.	Re-start PC or re-install Cam Loader.
D106h	Error during disconnection from the OPC server.	Re-start PC or re-install Cam Loader.
Errors during data import		
D201h	Error during the start of the "DriveData" component. <ul style="list-style-type: none"> Component has not been installed or has not been registered correctly. 	Re-install Cam Loader.
D202h	Error during reading the product data (motion profiles, cam tracks, position markers).	Check path and/or file name of the product data.
D203h	Error in the product data (motion profiles, cam tracks, position markers).	Check and correct file with the editor.
D204h	Error during reading the GDC parameter file. Faulty GDC parameter file data.	Check path and/or file name of the GDC parameter file. Check and correct file with the editor.
Errors during the creation of the LC9 file		
D301h	Error during the start of the "DriveLC9" component. <ul style="list-style-type: none"> Component has not been installed or has not been correctly registered. 	Re-install Cam Loader.
D302h	Error during setting the cam profile data (points).	Evaluate error description.
D303h	Error during setting the cam data.	Evaluate error description.
D304h	Error during setting the position data.	Evaluate error description.
D305h	Error during writing the LC9 file.	Check path for the LCx file. Check if there is enough free space available on your drive.
Errors during the creation of the LC7 file		

Error number	Cause	Remedy
D401h	Error during the start of the "DriveLC7" component. <ul style="list-style-type: none"> Component has not been installed or has not been registered correctly. 	Re-install Cam Loader.
D402h	Error during setting the cam profile data (points).	Evaluate error description.
D405h	Error during writing the LC7 file.	Check path for the LCx file. Check if there is enough free space available on your drive.
Errors within the DriveServer		
E7C18000	Error during download preparation.	Repeat download.
E7C18001	PLC has not stopped.	Stop the PLC program in the target system.
E7C18002	Controller inhibit has not been set.	Set controller inhibit in the target system (e.g. via terminal 28 or code C0040).
E7C18003	Incorrect data type (no LC9 file).	Create new LC9 file.
E7C18004	Check sum test is negative (faulty check sum).	Repeat download. Increase time-out time in the system bus configuration tool (e.g. to 3 seconds).
E7C18005	Item can momentarily not be accessed due to download.	Repeat download after a few minutes or restart your PC.
E7C18006	Target system is momentarily busy copying RAM blocks.	Start the PLC program in the target system.
E7C18007	Error occurred after the download.	Repeat download.
E7C18008	Error after version comparison during download of an LC7 file. <ul style="list-style-type: none"> Different versions in LC7 file and target system. 	Update the operating system of the 9300 EK.
E7C18009	No template "Cam" in the target system.	Create DDS project based on Template Cam and transfer it into the target system.

Global Drive Cam Loader

Appendix
Glossary

8.2 Glossary

A

Absolute data model	<p>Contains both the X and the Y coordinate. Therefore requires more space than the relative data model. The points are 1:1 transferred from the Cam Loader to the target system:</p> <ul style="list-style-type: none"> • Advantage: The distance between the points can be variable. This allows to optimise the distribution of the points according to the cam profile characteristics. • Disadvantage: Compared to the relative data model, less points can be saved. <p>▶ Relative data model</p>
Application window	Window in which programs are displayed under Windows.

C

Code	Lenze device parameter used to select the device functionality.
COM	Abbreviation for "Component Object Model": Architecture developed by Microsoft® for the interaction of separately executable software components (objects) that communicate with each other in the same way and are only connected to each other when the program is being executed.

D

DCOM	<p>Abbreviation for "Distributed Component Object Model": COM in which the executable objects can be distributed to different computers within a local network.</p> <p>▶ COM</p>
DDS	Abbreviation for "Drive PLC Developer Studio": Development environment for the creation of IEC 61131 programs for Lenze PLCs.
Document window	Window with graphical user interface displayed by a user program in which a document is created, displayed and edited. Document windows are usually sub-windows of the program windows.
Drive PLC Developer Studio	See DDS.
DriveServer	<p>Lenze software which enables easy integration of drives into open automation structures based on OPC ("OLE for Process Control").</p> <p>▶ OPC</p>

G

Global Drive Loader	Lenze software used to transfer PLC programs, parameter sets and application data to Lenze target systems.
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H

Hyperlink	Highlighted reference which is activated by a mouse click.
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I	
IPC	Abbreviation for Industrial PC. Industrial PCs are used in case of special environmental conditions, e.g. dirt or vibrations. They are slot CPUs with powerful processors and TFT displays (often with touch screens).
O	
OLE	Abbreviation for "Object Linking and Embedding": Integration of operational objects into other applications, e.g. Microsoft® Excel spreadsheets into Microsoft® Word documents.
OPC	Abbreviation for "OLE for Process Control": Defines an interface based on the Microsoft® Windows® technologies OLE, COM and DCOM which enables data exchange between different automation devices and PC programs regardless of driver and interface problems. <ul style="list-style-type: none"> ▶ COM ▶ DCOM
P	
PDF	Abbreviation for "Portable Document Format". Universal file format developed by Adobe for the exchange of electronic documents. The Adobe® Reader® is provided free of charge and can be used to display and print PDF files independently of the application and platform used to create them.
PLC	Abbreviation for "Programmable Logic Controller".
R	
Relative data model	Only contains the difference between adjacent Y coordinates and therefore requires less space than the absolute data model. The distance between the X coordinates is transferred as a fixed-comma value to the target system. This leads to a certain difference between the imported data and the coordinates calculated by the target system. To compensate for this inaccuracy, the Y values are re-calculated by means of interpolation . <ul style="list-style-type: none"> • Advantage: Compared to the absolute data model, more points can be saved. • Disadvantage: The distance between the X coordinates of the points must always be the same. ▶ Absolute data model
T	
Title bar	Bar at the top of the application window including the program icon and the program name on the left and the window icons on the right.
V	
VDI 2143	VDI guideline "Motion rules for cam mechanisms"
W	
Window icon	Button at the right end of the title bar which can be used to change the size of the window or to close the window.
Worksheet	Table including all axes and products of a system or machine project.

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