

CAM Expert

User Reference Manual

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Preface

Scope of This Manual

This manual describes the CAM module of CAM Expert only. Please refer to the QCad manual for all CAD related functionality.

CAM Export

CAM Expert was designed for creating NC programs for engraving and LASER cutting machines. Later, it was extended by functions used for various other machine types. However, it's not a 3D milling program, even if it's possible to work with different Z-levels for different layers, it's still a 2D CAM application.

Menu:

CAM - CAM Export..

The CAM Options Dialog

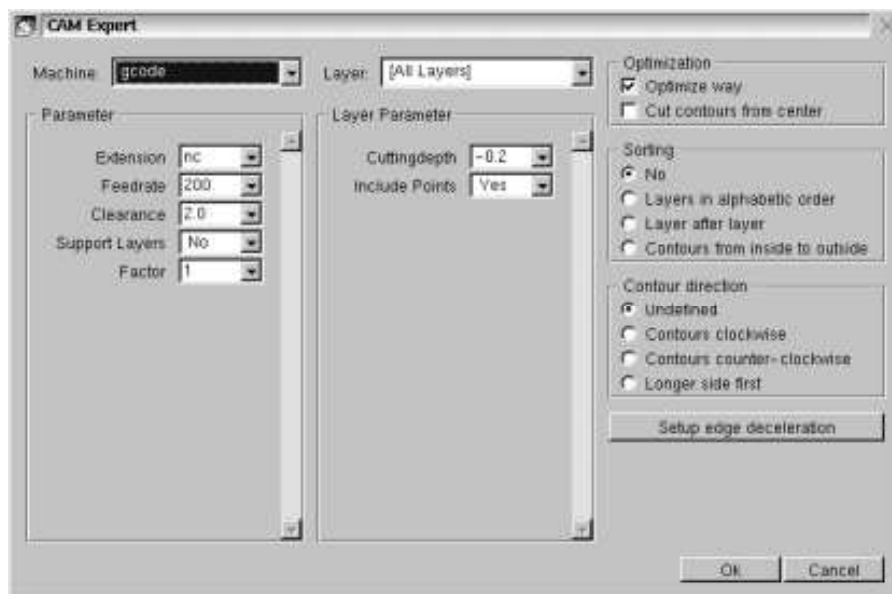


Figure 1: The CAM dialog box.

Machine Generator

Choose a machine generator from the "Machine" combobox. The machine generator contains all machine specific parameters for a particular machine type. Further, it contains standard settings for the optimization and sorting options. After selecting a machine generator, all its standard settings are shown in the CAM dialog.

Parameter

Adjust the values in the "Parameter" frame at the left. These parameters are machine dependent. You can for example set the feed rate, the clearance, the file extension or any other settings which were programmed by the creator of the machine generator.

Layer Settings

If you want to use different settings for different layers you can now choose layer by layer in the "Layer" combobox and adjust the values for the chosen layer in the "Layer Parameter" frame at the middle of the dialog.

To change the settings for all layers at once, choose "[All Layers]" from the "Layer" combobox and adjust the values in the "Layer Parameter" frame. If the settings are individual for each layer the parameter comboboxes appear empty. As long as you leave them empty, you don't change the individual settings for the single layers.

Optimizations

Tick the "Optimize way" check box if you want the program to be optimized for a shorter way. CAM Expert will then search the closest entity, process it and all connected entities and then move to the next, closest unprocessed entity.

Cutting From Center

Tick the check box "Cut contours from center" to cut all closed contours from their center. This option is useful if you cut small rectangles and circles with a LASER cutting machine. The best result can be made, if you combine this option with the option "Longer side first".

Sorting

Choose the sorting:

- **No:** Cut Objects in no special order.
- **Layers in alphabetic order:** Cut Layers in alphabetic order.
- **Layer after layer:** Cut all objects on a layer and go on to the next layer.
- **Contours from inside to outside:** Cut contours from inside to outside. This avoids the cutting of a contour before all objects in the inner of the contour are cut. This option is usually used for sheet metal cutting.

Contour Direction

Closed contours can be cut in a defined direction:

- **Undefined:** No defined direction for contours.
- **Clockwise:** Cut all closed contours clockwise.
- **Counter clockwise:** Cut all closed contours counter clockwise.
- **Longer side first:** Cut the longest side first. This option is useful if you cut small rectangles and combine this with the setting "Cut contours from center".

Creating The NC Output

After leaving the CAM dialog box, a file selection box appears, where you can choose a path and name for the output file. You can type the name with or without extension. If you type no extension, the default extension defined in the machine generator is used.

Creating the output file can take a while, depending on the optimization, the drawing size and the machine generator. CAM Expert opens a preview of the output when the conversion is done.

After The Creation

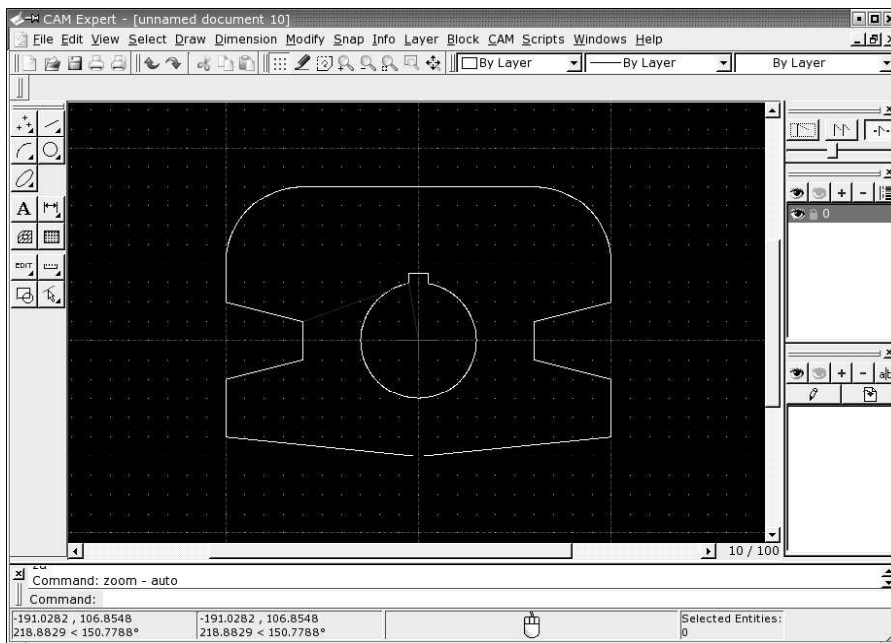


Figure 2: CAM Expert in its simulation mode.

You can use the tools in the simulation panel (top right) to simulate the created file. Please refer also to chapter [CAM Simulation](#) for more information about the simulation tools.

CAM Simulation

The simulation panel is shown beside the drawing frames. It offers some tools for simulating the CNC programs.

Simulating The Graphic



Click to start the simulation. Use the speed bar at the bottom of the simulation panel to regulate speed during simulation.

Simulating The Drawing In Slow Mode



Click to start the simulation in slow mode. The entities of the graphic are drawn slowly enough that you can see the direction in which they will be cut. Use the speed bar at the right side to regulate speed during simulation.

Showing The Rapid Movement



Switch to show / hide the rapid movement. The rapid movement is shown in blue color.

CAM Configuration

CAM Expert uses so called machine generators for specifying individual NC formats. A machine generator is a configuration file in the sub directory "machines" of CAM Expert. This file contains different sections which start with a line in squared brackets.

Machine Generator Sections

Section	Description
[Description]	Brief description of the generator file
[Standards]	Standard values for general settings for sorting, optimizations, and other parameters.
[Parameter]	Machine dependent parameters.
[LayerParameter]	Machine dependent parameters which can have individual values for each layer.
[Code]	The code for all orders of this machine.

Section **[Description]**

This section is just for your own information. Put your comments about this machine generator in this section. The section must be surrounded by curly braces.

Section **[Standards]**

In this section you can define standard values for some general conversion options. The following table describes all options more detailed.

Option Name	Description
Extension	File extension for the output. E.g. "NC".
ContourStartInHeader	Defines, if the program header in the [Code] section contains the start of the first contour or not. It can be useful to define the contour start of the first contour in the header if it is different than the other contour starts. This value must be '1' or '0'.
LayerStartInHeader	Defines, if the program header in the [Code] section contains the start of the first layer or not. It can be useful to define the layer start of the first layer in the header if it is different than the other layer starts. This value must be '1' or '0'.
Optimization	Standard setting for optimization. '1'=on, '0'=off. Changeable by the user.
ContourCenter	Standard setting for cutting the contours from their center. '1'=on, '0'=off. Changeable by the user.
Sorting	Standard setting for sorting. 'n'=No sorting, 'a'=Layers in alphabetic order, 'l'=Layer after layer, 'c'=Contours from inside to outside. Changeable by the user.
Direction	Standard setting for contour direction. 'n'=No special direction, '2'=Clockwise, '3'=Counter-clockwise, 's'=Longer side first. Changeable by the user.
StartNumber	Start number for numbering the NC program.
NumberStep	Step between the numbers of the NC program.
MaxArcAngle	The maximum angle arcs can have. Some machines don't allow arcs which have more than 180. You can limit the angle to any desired value. All arcs which have a bigger angle get divided into smaller arcs. A value of zero means that there's no limit for angles.
MaxArcLength	The maximum length arcs can have. Usually this option is used for machines which can't make arcs at all. The NC order used for arcs can be an order for a straight line in such cases. If you choose the maximum angle length to be very small, arcs will be formed with lots of small straight lines.
Tolerance	The maximum gap between elements of the same contour. It's usually no good idea to type zero here because there's mostly a very small gap between elements. If there is a gap which is within this given tolerance, a small element is put between to build a bridge between the elements.
Digits	The number of digits coordinates should have after the point (decimal points). E.g. if the coordinate is 2.3567 and "Digits" has a value of '2', the NC program will contain the number 2.36.
Factor	Scale factor of the output. If the output

Some of these options can be changed by the user for every conversion in the CAM dialog. If you wish that the user can change even more options, you can type a parameter instead of a value. However, you need to define the parameter in the [Parameter] section below. For example if you wish that the user can choose the factor of the output for each conversion, type '\$c' instead of a fixed value. Later in the [Parameter] section you need to define the parameter '\$c' as the factor of the output.

Section [Parameter]

In this section you can define individual parameters. These parameters are shown in the left part of the CAM dialog. A typical definition of a parameter is:

The definition must start with "Parameter". Then follows "free" or "fixed". "free" means that the user can type whatever he wants. "fixed" allows the user only to choose a value from the given list. "\$f" is the parameter variable. Wherever you wish to insert the parameter in this file, you can type this variable in exactly this form "\$f". "Feedrate" is the label, shown for the user. It should be as short and significant as possible. Spaces are not allowed. You can use "_" (underscores) instead. "150" is the default value. It's used if the user doesn't change anything. Afterwards follows a list of other values the user can choose from. If the parameter is "fixed", the user can **only** choose from this list.

Please note that the parameter "\$_" is reserved for the name of the current layer.

Section [LayerParameter]

This section is very similar to the section [Parameter]. The only difference is that the user can choose different values for these parameter for each layer of the drawing. That's usually used is the different layers must be cut with different feed rates or in individual cutting depths.

Please note that the parameter "\$_" is reserved for the name of the current layer.

Special Parameters

The parameter "\$_" was introduced with CAM Expert version 2.4.6. It's used to refer to the layer name of the current element. However, this parameter must be updated in an order using the order "<UpdateLayer>". This way you can for example control, if the parameter "\$_" still contains the layer name of the last element in an "<OrderToolUp>" or already the layer name of the next element. Usually it is convenient to call "<UpdateLayer>" in the order "<OrderContourEnd>" or "<OrderToolUp>" or in the order in which you do the rapid movement between contours (e.g. "<OrderRapidMove>").

The parameter "\$_" can be used to insert the name of the current layer or in if constructs to insert a code part only for certain layers. An example for the second use could be:

This feature can have various uses. Some use two different layers for two spindles of your machine. Please note that for layer dependent values you can often use the layer parameters instead.

The parameters "\$@" and "\$#" can be used to insert the name or the path and name of the currently generated file. You can also use them in if-constructs to create file name dependent parts (not recommended). More likely you want to use the file extension in if-constructs to check for the chosen file type. It is stored in the parameter "\$%".

Section [Code]

That's the main section of a machine configuration. It contains the definitions for all orders for the output file. An order is defined in the form:

There are four types of orders: predefined orders, special orders, standard orders and additional orders. To make the whole section more clear, it's often a good idea to create your own additional orders which can then be included inside the other orders.

Predefined Orders

The following table shows the predefined orders which are used very often in other orders. Note: relative coordinates relate to the current position.

Order Name	Description
<NewLine>	Makes a linefeed in the output file at this place. Please note, that making a linefeed in the configuration file, doesn't automatically result in a linefeed in the output file.
<Number>	Inserts the current number. This number starts with the given start number in the [Standards] section and gets increased by the given number step on each use.
<X1Abs> <Y1Abs>	The start point of the current element in absolute coordinates.
<X2Abs> <Y2Abs>	The end point of the current element in absolute coordinates.
<X1Rel> <Y1Rel>	The start point of the current element in relative coordinates.
<X2Rel> <Y2Rel>	The end point of the current element in relative coordinates.
<IAbs> <JAbs>	The center point of the current arc/ circle in absolute coordinates.
<IRel> <JRel>	The center point of the current arc/ circle in relative coordinates.
<A1> <A2>	Start and end angle of the current arc in degrees.
<A>	Angle amount of the current arc.
<Radius>	Radius of the current arc/ circle.
<Diameter>	Diameter of the current arc/ circle.
<MinX>	Left border coordinate of the current element.
<MaxX>	Right border coordinate of the current element.
<MinY>	Bottom border coordinate of the current element.
<MaxY>	Top border coordinate of the current element.
<UpdateLayer>	This order doesn't actually insert any code. It's used to update the special parameter "\$_" which is described in detail above.
<FillLine>	This order is used to achieve an equal line length for every line. The line length can be set using the option "LineLength" in section [Standards]. E.g.: If you want to achieve that all lines get filled up with spaces in the end of the line up to a length of 100 characters, you can define your own line feed order which would look like that: MyNewLine {<FillLine> <NewLine>} Then call <MyNewLine> instead of <NewLine> for line breaks in other orders.

Special Orders

Order Name	Description
<if:...>...</if>	<p>This order pair is used to build an if construct around other orders. It must contain a condition. If this condition is true, the contents between <if:...> and </if> is active. Otherwise it's not processed. Possible conditions are:</p> <p><if:poschanged1>...</if> Only processed if the start point of the current element differs from the current position.</p> <p><if:poschanged2>...</if> Only processed if the end point of the current element differs from the current position.</p> <p><if:contourbegin>...</if> Only processed if the current element is the first element of a contour.</p> <p><if:contourend>...</if> Only processed if the current element is the last element of a contour.</p> <p><if:contourmiddle>...</if> Only processed if the current element is not the first and not the last element of a contour.</p> <p><if:p=Yes>...</if> Only processed if the parameter (here: "p") equals the string given at the right (here: "Yes").</p> <p><if:n!=Blah>...</if> Only processed if the parameter (here: "n") does not equal the string given at the right (here: "Blah").</p>
<mod:1>...</mod:1>	<p>The string between this order pair is only processed if it differs from the last processed string in the same order pair. This is used for modal order parts which remain active once they're used until an other order comes. For example a G01 order remains active until a G02, G03 or G00 command comes.</p> <p>Valid numbers range from 1 to 9.</p> <p>Example: <mod:1>G01 </mod:1></p>
<delmod:1>	<p>This order is used for resetting a <mod:1>...</mod:1> order pair. For example it can be used after a G02 if the G02 command deactivates a G01, G00 or G03 but doesn't stay active itself.</p> <p>Valid numbers range from 1 to 9.</p> <p>Example: G02 <delmod:1></p>

Standard Orders

Standard orders are called by CAM Expert. You need to define at least some of these orders to get a convenient result.

Order Name	Description
<OrderProgramStart>	<p>Called before the first element. With this order the machine must be made ready for cutting the first element. It must move to the first coordinate (usually done with a call of <OrderRapidMove>) and move the tool down (call of <OrderToolDown>)</p> <p>Example:</p> <p>OrderProgramStart {N<Number> M05 <NewLine>N<Number> G90 <NewLine>N<Number> G00 X0.0 Y0.0 <OrderRapidMove> <OrderToolDown>}</p>
<OrderProgramEnd>	<p>Called after the last element. This order must bring the machine to it's initial status.</p> <p>Example:</p> <p>OrderProgramEnd {<NewLine>N<Number> G00 Z100.0 <NewLine>N<Number> M30 <NewLine>}</p>
<OrderLayerStart>	<p>Called before every element which is on a different layer than the last one. Use this order to change layer dependent settings. E.g. you can change the feed rate to the feed rate of the new layer.</p> <p>Example (Let's suppose l is a parameter which lets the user choose whether he wants to support layers ("Yes") or not ("No") and f is a layer dependent parameter for the feed rate):</p> <p>OrderLayerStart OrderLayerStart {<if:\$l=Yes> <NewLine>N<Number> Ff</if>}</p>
<OrderLayerEnd>	<p>Called after the last element of a layer if the next element is on a different layer. Maybe you want to put in a comment to the program here.</p> <p>Example:</p> <p>OrderLayerEnd OrderLayerEnd {<if:\$l=Yes> <NewLine>N<Number> (Layer ends here)</if>}</p>
<OrderContourStart>	<p>Called if the current element is the first element of a new contour. This order must contain all necessary orders to move to the first point (usually <OrderRapidMove>) of the new contour and move the tool down (usually <OrderToolDown>).</p> <p>OrderContourStart {<OrderRapidMove> <OrderToolDown>}</p>
<OrderContourEnd>	<p>Called after the last element of a contour. This order must contain all necessary orders to move the tool up (usually <OrderToolUp>) or somehow else make the machine ready to rapidly move to the start point of the next</p>

Special Characters

As the special sign " is used in the configuration file to insert parameters, you need to type " for writing one " sign in the output.

Further, the brackets '{', '}', '<' and '>' are used for formatting the configuration file. If you need to produce such brackets, you must type the substitutions from the following table. Please note also that multiple spaces result in just one space in the output. If you need to write more than one space, you must use the substitution for it.

Sign	Substitution
{	&lbra;
}	&rbr;
<	⟨
>	⟩
' ' (Space)	&spac;
Any character (printable or binary)	� ... ÿ (The decimal code of the character)

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