



C-Prompt Software & Design
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GGG

Generic G-code Generator

Version 2.0

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1. General description

Generic G-code Generator is a software program that extracts information about a work piece from a two-dimensional AutoCAD drawing and converts this information into g-code. This code can then be used as programming base for a numerical controlled machine that works in an XY plane. The program was written in AutoLISP language. It runs as a subroutine under AutoCAD and is very easy to use. The user decides the order of machining steps and the direction of the machining paths through a simple yet efficient point-and-click interface. With a few mouse clicks *Generic G-code Generator* can be instructed to apply either a straight or a curved approach into the machining path and to use a fixed or a variable start distance for this procedure. Utilization of cutter diameter compensation codes makes it possible to process parts drawn in their original size.

2. Summary of g-codes generated by the program

- G00** - *Positioning* : used to **position** the tool or the work to the start of a new machining path
- G01** - *Linear Interpolation* : for machining in **straight lines** along one or two axes
- G02** - *Circular Interpolation, CW* : for machining of **arcs** or **circles** in **clockwise** direction
- G03** - *Circular Interpolation, CCW* : for machining of **arcs** or **circles** in **counter clockwise** direction
- G41** - *Cutter diameter compensation, left* : to **offset** the center of the tool to the **left** by the amount required by the diameter of the cutting tool
- G42** - *Cutter diameter compensation, right* : to **offset** the center of the tool to the **right** by the amount required by the diameter of the tool
- G40** - *Cancel cutter compensation* : to **cancel** previously applied cutter compensation code

3. Program requirements

Some requirements must be fulfilled for *Generic G-code Generator* to work properly :

- The shape to be converted into a machining path must be **entirely visible** on the drawing screen at the time it is selected.
- A shape may consist only of **lines** and **arcs** or a **circle**. All complex entities, e.g. polygons, polylines or blocks must be exploded before they can be processed.
- Entities of a shape must be **connected** at their **endpoints**.
- All entities of the **same shape** must be located on the **same layer**.

Generic G-code Generator needs a number of AutoCAD environment settings to be of a certain value. If one or more settings in the drawing differ from these preferences, then the user will be prompted to change them, or the program will make the changes automatically. The required settings are:

Coordinate System :	world
Units of measurement :	decimal
Precision :	at least 3 digits after decimal point
Angle direction :	counter clockwise
Angle base :	0 degrees in “east” position

4. File Installation

Copy all files from the distribution diskette to the folder on your hard drive in which the file named *Acad.exe* is located.

5. Loading the program

To use *Generic G-code Generator*, it must be loaded every time after a drawing was opened. The easiest way to do this is to type at the command prompt:

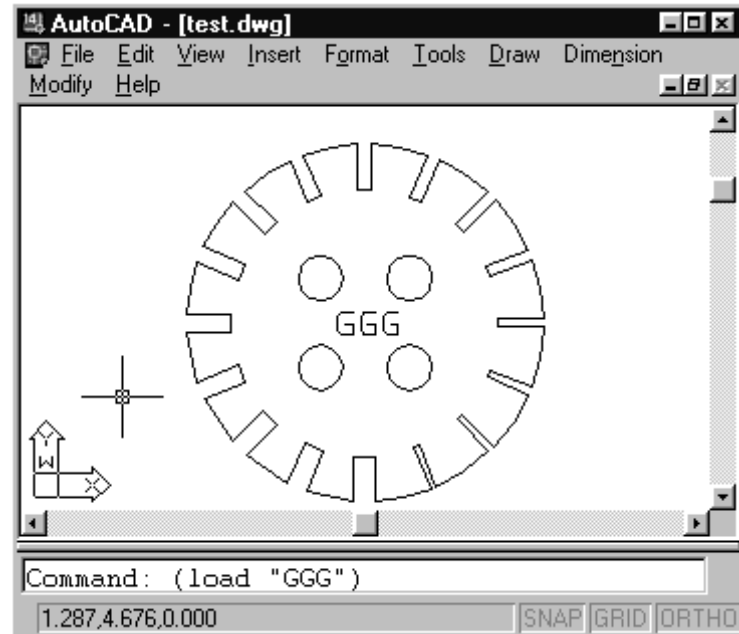
(load "GGG")

as shown in the picture on the right (the parentheses are required).

It is also possible to have AutoCAD load the program automatically.

One method to accomplish this is to open the file *Support/Acad.mnl* in a text editor program and, at the very end, add the line:

(defun S::StartUp () (load "GGG")(princ))



6. Calling the program

Once the program is loaded, the following line is printed in the text area of the screen:

Generic G-code Generator ver. 2.0 loaded. Type 'GGG' at the command prompt.

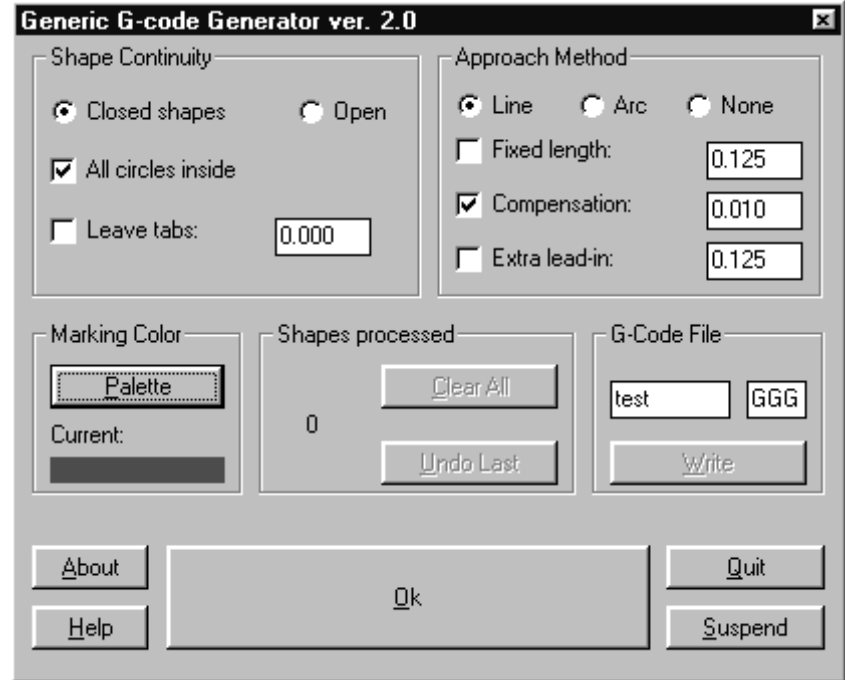
Generic G-Code Generator is now ready to be used. It may be called at any time during the present AutoCAD session by typing the command

GGG

and pressing the Enter key. When this is done, the program's control window appears.

Parameter selections, value specifications and calls to all of *Generic G-Code Generator's* sub-functions are made from within here. The control window is divided into individual sections.

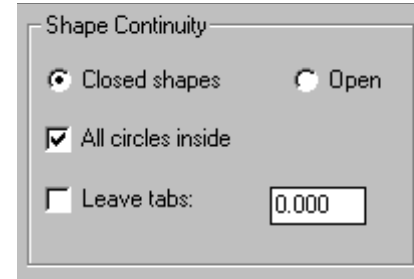
The following pages contain explanations for each of them.



7. Sections of the control window

7.1 Shape continuity

Generic G-code Generator can process open shapes and closed shapes that are made up of line entities, arc entities or circles. Each shape must be in the form of a single continuous path, i.e. its individual entities must be connected at their endpoints, and a maximum of one other entity can be connected to each endpoint of each entity.



To process a closed shape the **Closed shapes** option must be selected. In this setting *Generic G-code Generator* will accept only shapes that have no endpoint.

If the box labelled **All circles inside** is checked and the selected shape is a circle, then direction and startpoint need not be specified. Instead, all applicable approach method parameters are being applied automatically to the inside of the circle.

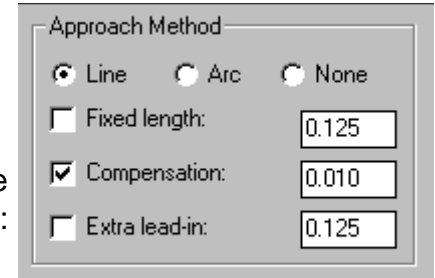
If the box labelled **Leave tabs** is checked, then the machining of the selected shape will stop at the specified distance before the end of the shape and leave a "tab". For this feature to work properly, the start of the last entity in the shape must be at least as far away from the endpoint of the path as specified in the tab distance box.

To process an open shape the **Open** option must be selected. In this setting *Generic G-code Generator* will accept only shapes with definite endpoints.

Neither one of the checkbox functions is applicable to open shapes. The *approach method* for all open shapes is automatically set to *None* (see next page).

7.2. Approach method

The approach method specifies additional steps that are executed before the machining of the actual shape begins. For the processing of open shapes only the option **None** is available, meaning no additional steps are being applied. The two options available for the processing of closed shapes are:



Approach Method		
<input checked="" type="radio"/> Line	<input type="radio"/> Arc	<input type="radio"/> None
<input type="checkbox"/> Fixed length:		<input type="text" value="0.125"/>
<input checked="" type="checkbox"/> Compensation:		<input type="text" value="0.010"/>
<input type="checkbox"/> Extra lead-in:		<input type="text" value="0.125"/>

Line The shape is approached by machining a straight line from the starting point perpendicular to the shape's first entity.

Arc The shape is approached by machining an arc that begins at the starting point and enters the shape's first entity in a seamless transition.

If the box labelled **Fixed length** is not checked, then the starting point of the approach line/arc will be the point that was clicked (see 'selecting shapes'). Otherwise the starting point will always be at the specified fixed distance from the shape.

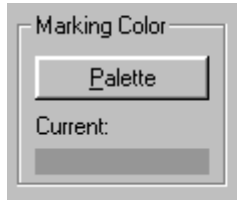
If the box labelled **Compensation** is checked, then the appropriate tool width compensation commands are going to be issued before and after the machining of the actual shape. Along with each of these commands an additional straight line of the specified length will be machined. These lines will be running parallel to the X-axis or the Y-axis. The first one will be machined before the approach line/arc begins, and the second one will be done after the end of the shape.

If the box labelled **Extra lead-in** is checked, then a straight line will be machined as the very first step, even before compensation and approach line/arc. This line will begin at the specified distance from the starting point at an angle perpendicular to the shape's first entity.

All steps of the approach method as well as the machining of the actual shape will be drawn on the *g-code* layer using the chosen *marking color* (see next page).

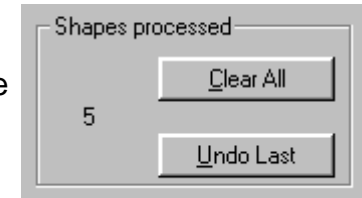
7.3. Marking color

When *Generic G-code Generator* is loaded, a new layer named **g-code** is added to the drawing. Every time a shape is selected and conforms to the shape continuity parameters, then it is accepted for processing. All applicable approach method parameters are being applied to the shape, and at the same time, drawn on the *g-code layer* using the current marking color. This color can be selected from a menu which is accessed by pressing the **Palette** button. Different colors may be used during the same g-code generator session.



7.4. Shapes processed

The total number of shapes that have been processed is shown in this section. Pressing the **Clear All** button will clear the entire shape selection and erase the content of the *g-code layer*. Pressing the **Undo Last** button will invoke AutoCAD's undo function. The respective last shape will be removed from the selection and from the *g-code layer*. This function may also be invoked from the tablet or the keyboard during a *shape selection* process. Only shapes that were processed during the current g-code generator session can be undone. The ones processed in a previous session are removed by clicking the *Clear All* button. Shapes made in another drawing session, and saved along with the drawing, although still visible on the *g-code layer*, will not be part of the processed shapes selection and therefore will not be written to the *g-code file*. They too, can be erased using the *Clear All* button.



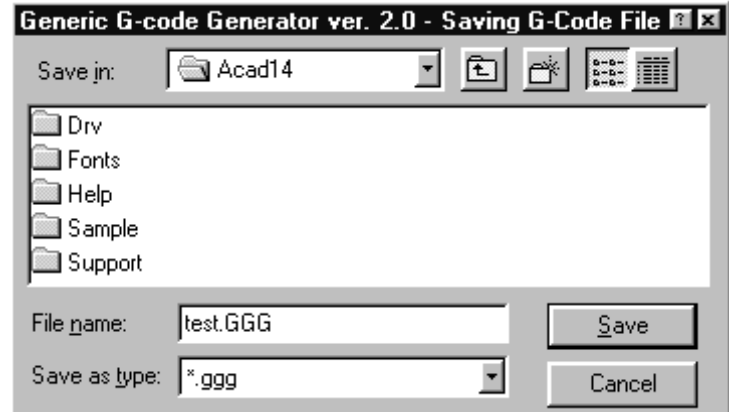
7.5. G-Code File

The *g-code file's* name and extension are specified in this section. When *Generic G-code Generator* is started for the first time in a particular drawing session, the name of the *g-code file* will be the same as the name of the drawing. The operator may change it for the duration of the drawing session. The extension may also be changed, it will keep its setting for the present and all future AutoCAD sessions, until it is changed again.

When the **Write** button is pushed, a file dialog window like the one shown here will appear, enabling the operator to select the destination folder for the *g-code file*. Pushing the **Save** button will write the appropriate g-code commands for each of the processed shapes to the file. This will be done in one of two ways. Either the respective g-code for linear interpolation or circular interpolation will be written at the start of every line, or it will be omitted in cases where the previous command was of the same type.

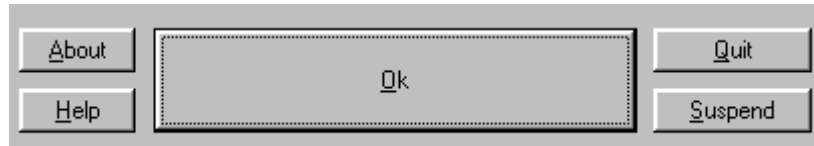
The commands **MinGCode** and **MaxG-Code** (to be entered at the command prompt) determine which method will be used. The default setting is to omit repeating g-codes (*MinGCode*). Once changed, the new setting will be used until it is changed again.

Every time after a *g-code file* has been written to disk, the *Clear All* command is executed.



7.6. Main buttons

Ok Pushing this button starts several procedures. First all parameters are saved to disk. Then the control window is closed and a command prompt appropriate to the *shape continuity* parameter settings is displayed. Now the *shape selection* process begins (see next page).



Suspend Exits the current g-code generator session. All processed shapes will remain in the selection. However, they can not be undone individually in a new generator session. To start a new generator session the command **GGG** must be typed again. The suspend function is called automatically whenever an AutoCAD command other than *undo* or *zoom* was invoked from the tablet during a *shape selection* process.

Quit Calls the *Clear All* function and terminates *Generic G-code Generator*.

Help Opens the on-screen help window. The on-screen help contains short descriptions of *Generic G-code Generator's* main functions.

About Displays program name and version number.

8. Selecting shapes

8.1. Selecting open shapes

The command line displays the prompt:

<Select start of open shape>:

A point on the shape must be clicked using the **primary mouse button** (*usually the left one*).

This point must be situated close to the startpoint of the first entity in the shape at which the machining should begin. If the point was found the processing of the shape begins, and entity after entity of the shape is re-drawn on the *g-code* layer. When this is done, the next open shape can be selected by applying the same procedure.

If a closed shape is to be selected, then the control window must be brought up first. This is accomplished at any time by pressing the **secondary mouse button** (*usually the one on the right*).



8.2. Selecting closed shapes

Whenever the *shape continuity* option **Closed** was selected, then the command line will display the prompt:

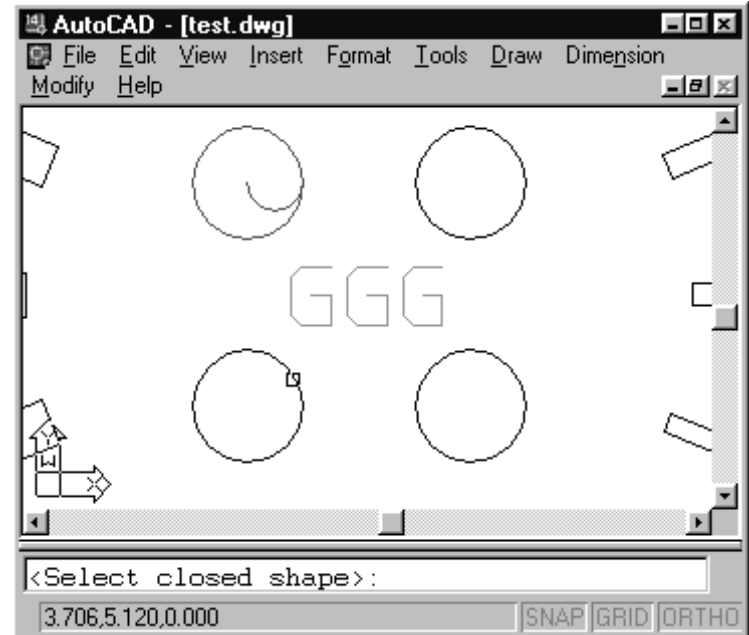
<Select closed shape>:

8.2.1. Round holes

Round holes can be treated as a special kind of closed shapes. If the box labelled **All circles inside** was checked, and the selected shape is a circle, then all applicable *approach method* settings are automatically applied to its inside. Regardless of which point was clicked, the approach

path will always end at the 0 degrees point on the circle's perimeter, and the machining of the circle will be done in counter clockwise direction. If the Fixed length box was not checked or if the value for the fixed length was greater than the circle's radius, then the approach arc/line will start at the circle's center point. However, no automatic correction is going to be done for *compensation lines* and *extra lead-ins*.

It is possible to use the *all circles inside* setting together with the *leave tabs* feature.



8.2.2. Other closed shapes

If the selected closed shape is not a circle or the *All circles inside* feature is not used, then the operator must specify the direction of the machining path and, if applicable, the starting point for the approach arc/line. The displayed prompt is going to be either

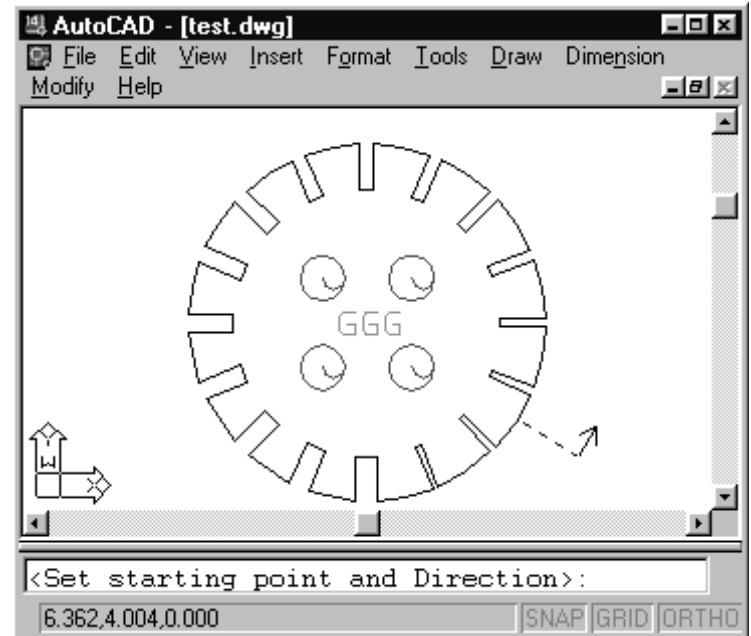
<Choose Direction> or

<Set starting point and Direction>

The cursor changes into an arrow. If *Line* approach is used, a solid line runs from the root of the arrow perpendicular to the selected entity. For an *Arc* approach a dashed line is drawn, and no line is shown if *None* was selected.

Pointing in the direction of the movement, the arrow will follow the mouse if the perpendicular line can be drawn. When the **primary mouse button** is clicked, the direction is accepted. If an approach path is to be machined, and no fixed length is used, then the root of the arrow will become the starting point for the approach line/arc. For fixed length approaches the starting point will be on the perpendicular line at the specified distance from the entity. **Exception:** If an entity was selected by its midpoint, then the approach will be re-arranged to enter the shape at this exact point.

The process can be aborted at any time by pressing the **secondary mouse button**.



9. Error messages



No entity could be detected at the endpoint of the currently processed entity.

Possible causes :

- a gap between two entities of a shape
- current entity extends beyond next one

Solution : Apply the AutoCAD command **EXTEND** or **FILLET** (*radius 0*) or **TRIM** to assure the two entities are connected.



An entity was detected at the endpoint of the current entity, but neither of the new entity's endpoints matches the endpoint of the current one.

Possible cause :

- new entity extends over current entity

Solution : Apply **FILLET** (*radius 0*) or **TRIM** to assure the next entity ends at the current entity.



More than one new entity was detected at the end point of the current entity.

Possible causes :

- an entity is copied onto itself
- an entity that is not part of the shape crosses the path of the shape (*dimension lines etc.*)

Solution : **ERASE** all entities not to be part of the shape or **MOVE** them to a different drawing layer.

(error messages, continued)



At least one endpoint of an entity in the selected shape is not inside the viewing area.

Possible cause :

- the shape extends beyond the borders of the graphics screen area

Solution : **ZOOM** out



The selected shape or at least one entity in the selected shape is neither a line, nor an arc nor a circle.

Possible cause :

- a complex entity type was detected in the shape (e.g.: *Polyline, Polygon, Block, Text*)

Solution : **EXPLODE** all complex entities or **ERASE** and redraw the shape using only lines and arcs, or a circle.



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