CNC

8060
8065

ProGTL3 language

(Ref. 1402)

FAGOR

FAGOR AUTOMATION

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The content of this manual and its validity for the product described here has been verified. Even so, involuntary errors are possible, thus no absolute match is guaranteed. Anyway, the contents of the manual is periodically checked making and including the necessary corrections in a future edition. We appreciate your suggestions for improvement.

The examples described in this manual are for learning purposes. Before using them in industrial applications, they must be properly adapted making sure that the safety regulations are fully met.

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1 INTRODUCTION.

This document describes the programming syntax, operation and usage of the ProGTL3 (Professional Geometric Technological Language 3) language. The PROGTL3 language consists in several G functions that make editing profiles quick and easy. This language has evolved from previous oriented programing languages because it offers the user the possibility to program ProGTL functions (for defining straight lines and circles that define the intersection points of the profile) and ISO functions (to define segments and arcs of the profile).

1.1 G functions to expand geometry features.

·G·	Meaning.	
G801	Ray or segment.	*3.1*
G802	Clockwise circle or arc.	*3.2*
G803	Counterclockwise circle or arc.	*3.2*
G808	Arc tangent to previous path.	*3.3*
G809	Arc by two points and beginning at the previous end point.	*3.4*
G810	First point or circle to define a straight line.	*2.1*
G811	Second point or circle to define a straight line.	*2.1*
G813	Definition of a straight line that goes through a point or is tangent to a circle and forms a known angle with the abscissa axis.	*2.2*
G820	Define a circle or a point.	*2.3*
G821	Define a rounding or an arc. Define a chamfer.	*2.5*
G831	Ray or segment tangent to previous path.	*3.5*
G832	Circle or clockwise arc tangent to previous path.	*3.6*
G833	Circle or counterclockwise arc tangent to previous path.	*3.6*
G840	Linear or tangential exit and cancellation of tool radius compensation.	*2.6*
G841	Begin profile with left-hand tool radius compensation.	*2.7*
G842	Begin profile with right-hand tool radius compensation.	*2.7*
G850	Cancel rotational offset.	*2.8*
G851	Activate rotational offset.	*2.9*

1.2 Summary of G function syntax.

G function syntax (ProGTL functions).

Function.	Parameters.	Description.
[G810]	[X Y] circle center or support point [I] radius	Circle center or first support point for the straight line.
G811	[X Y] circle center or support point [I] radius [K] Intersection number.	Circle center or second support point for the straight line.
G813	[X Y] circle center or support point [I] radius [J] angle	Straight line.
G820	[X Y] center [I] radius [K] Intersection number.	Circle with known center and radius.
	[X Y] point1 [X Y] point2 [I] radius	Circle by two points and known radius.
	[X Y] point1 [X Y] point2 [X Y] point3	Circle by three points
G821	[I] Rounding radius [J] Chamfer size	Define a rounding or an arc. Define a chamfer.
G840	[X Y] exit point [K] exit type [I] radius	Linear or tangential exit and cancellation of tool radius compensation.
G841 G842	[X Y] joining point [K] Type of joint [I] radius	Begin profile with left-hand or right-hand tool radius compensation.
G850	Cancel G851.	Cancel rotational offset.
G851	[X Y] zero offset/rotation point [J] angle [K] Type of rotation/offset	Activate rotational offset.

G function syntax (ISO functions).

Function.	Parameters.	Description.
G801	[X Y] end point [J] angle	Ray or segment.
G802 G803	[X Y] end point [I J] center [I1=] radius	Circle or arc.
G808	[X Y] end point	Arc tangent to previous path.
G809	[X Y] end point [I J] intermediate point	Arc by two points and beginning at the previous end point.
G831	[X Y] end point [J] angle	Ray or segment tangent to previous path.
G832 G833	[X Y] end point [I J] center [I1=] radius	Circle or arc tangent to previous path.

2 PROGTL3 LANGUAGE.

The functions of the PROGTL3 language (G810, G811, G813, G820, G821, G840, G841, G842) allow programming tool paths by defining the end point of each segment as an intersection of two segments. These segments as opposed to the segments and arcs of the ISO language, are straight lines and circles. This way, with these functions the profile is defined as the result of the intersections between the straight lines and the circles that make it up.

The characteristics of these functions are the following.

- The coordinates can be programmed in inches, millimeters or with a scaling factor.
- The data that is left out may be recovered from the last programmed data.
- In the circles, the radius is defined with I (negative for clockwise direction and positive for counterclockwise).
- Programming incremental coordinates (G91) affects the abscissa, ordinate, radius and angle.

2.1 G810-G811. Straight line through two points or tangent to two circles.

Defining a straight line that goes through two points always consists in two program blocks that indicate the two support elements.

- A straight line going through to points.
- A straight line that goes through one point and is tangent to a circle.
- A straight line that is tangent to a circle and goes through a point.
- A straight line tangent to two circles.

The programming format is:

- [G810 [X...] [Y...] [Z...] [A...] ….[I...]]

  Firs circle or support point.
- G811 [X...] [Y...] [Z...] [A...] … [I...] [K...]

  Second circle or support point.

Firs circle or support point.

G810 First support point or first support circle tangent to the straight line.

Optional; if left out, it will use the point (or circle) of the previous block.

Coordinates of the circle center or of the support point of the straight line.

[X...] [Y...] Cartesian coordinates in G17.

[Z...] [X...] Cartesian coordinates in G18.

[Y...] [Z...] Cartesian coordinates in G19.

[Q...] [R...] Polar coordinates.

Optional. The coordinates are programmed with the name of the axes and the values.

The point can also be indicated in incremental coordinates with G91. When programming one of the two axes of the plane and leaving the other one out, it will use the coordinate programmed last for the axis that is not programmed.

This data may be left out completely if it is identical to those of the last circle programmed in the same profile. In this case, where the radius I will not be programmed, either, if a circle has been defined in the previous block, the circle will be used as support circle for the straight line.

Coordinate axes that do not belong to the reference plane.

[Z...] [A...] Coordinate axes that do not belong to the reference plane.

In this block, the programmed coordinates are useful, in this case Z indicates the total depth to be reached at the end of the block.

Circle radius.

[I...] Circle radius. Optional.

Positive value for counterclockwise and negative for clockwise. If a G91 was programmed earlier, the radius value will be incremental. If the I value is written, the circle is calculated in the current plane; XY plane if in G17, ZX if in G18 and YZ if in G19.

If parameter I is left out, a point will be defined, not a circle. The I value defined in previous blocks will be ignored.

If the point is left out and only G810 I is used, it will use the point of the block defined last as the center of the support circle with an I radius.

Second circle or support point.

G811 Second support point or second support circle tangent to the straight line.

Coordinates of the circle center or of the support point of the straight line.

[X...] [Y...] Cartesian coordinates in G17.

[Z...] [X...] Cartesian coordinates in G18.

[Y...] [Z...] Cartesian coordinates in G19.

[Q...] [R...] Polar coordinates.

Optional. The coordinates are programmed with the name of the axes and the values.

The point can also be indicated in incremental coordinates with G91. When programming one of the two axes of the plane and leaving the other one out, it will use the coordinate programmed last for the axis that is not programmed.

This data may be left out completely if it is identical to those of the last circle programmed in the same profile. In this case, where the radius I will not be programmed, either, if a circle has been defined in the previous block, the circle will be used as support circle for the straight line.

Coordinate axes that do not belong to the reference plane.

[Z...] [A...] Coordinate axes that do not belong to the reference plane.

In this block, the programmed coordinates are useful, in this case Z indicates the total depth to be reached at the end of the block.

Circle radius.

[I...] Circle radius. Optional.

Positive value for counterclockwise and negative for clockwise. If a G91 was programmed earlier, the radius value will be incremental. If the I value is written, the circle is calculated in the current plane; XY plane if in G17, ZX if in G18 and YZ if in G19.

If parameter I is left out, a point will be defined, not a circle. The I value defined in previous blocks will be ignored.

If the point is left out and only G811 I is used, it will use the point of the block defined last as the center of the support circle with an I radius.

Intersection number.

[K...] Choice between the two intersections of the straight line with a circle programmed in the previous block. Optional.

K1 first intersection between the straight line and the circle moving in the direction of the straight line.

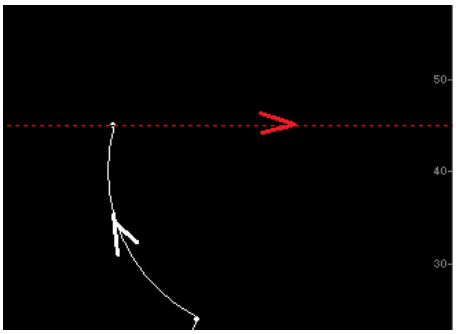
K2 second intersection.

If K is not programmed and there are more than one solution, the intersection selected automatically will depend on the previous element.

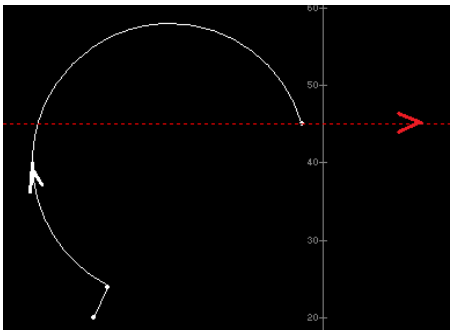
- If the previous element is a circle, the selected intersection will be the first one in the direction of the straight line.
- If the previous element is a rounding between a circle and the straight line and the straight line being programmed, the selected intersection will depend on the direction of the straight line, on the circle or on the rounding between the straight line and on the circle.

Examples.

Intersection of straight line with previous circle, there are two possible solutions, if K is not indicated, it will be equal to K1.

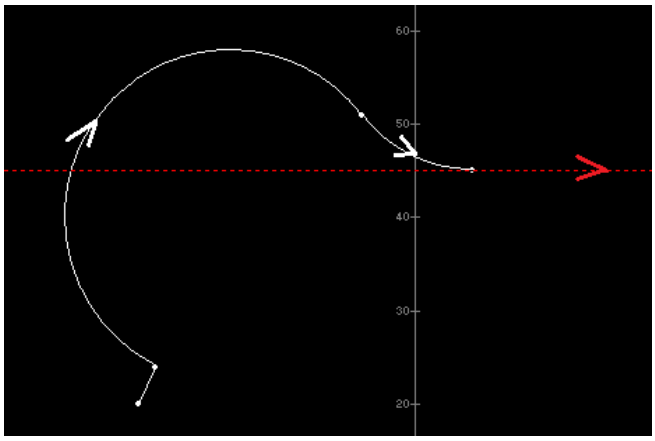


Intersection of a straight line with a clockwise circle if K=1.

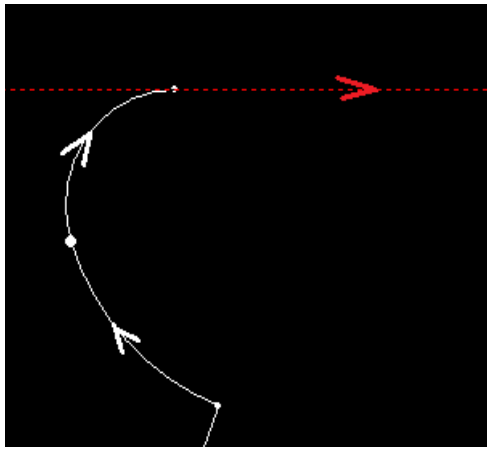


Intersection of a straight line with a clockwise circle if K=2.

Intersection of a straight line with a previous circle and rounding. There only one possible solution following the orientation of the profile.



Counterclockwise rounding. The profile is resolved with the first intersection.



Clockwise rounding. The profile is resolved with the second intersection.

2.2 G813. Definition of a straight line that goes through a point or is tangent to a circle and forms a known angle with the abscissa axis.

A straight line is defined as follows:

- G813 [X...] [Y...] [Z...] [A...] ….[I...] J... [K...]

  Definition of a straight line that goes through a point or is tangent to a circle and forms a known angle with the abscissa axis.

Coordinates of the circle center or of the support point of the straight line.

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

Optional. The coordinates are programmed with the name of the axes and the values.

The point can also be indicated in incremental coordinates with G91. When programming one of the two axes of the plane and leaving the other one out, it will use the coordinate programmed last for the axis that is not programmed.

This data may be left out completely if it is identical to those of the last circle programmed in the same profile. In this case, where the radius I will not be programmed, either, if a circle has been defined in the previous block, the circle will be used as support circle for the straight line.

Coordinate axes that do not belong to the reference plane.

[Z...] [A...]	Coordinate axes that do not belong to the reference plane.

In this type of block, the names of all the axes of the machine may be used. In this case, one must indicate the final depth of the axes to be reached at the end of the block.

Circle radius.

[I...]	Circle radius. Optional.

Positive value for counterclockwise and negative for clockwise. If a G91 was programmed earlier, the radius value will be incremental. If the I value is written, the circle is calculated in the current plane; XY plane if in G17, ZX if in G18 and YZ if in G19.

If parameter I is left out, a point will be defined, not a circle. The I value defined in previous blocks will be ignored.

If the point is left out and only G813 I is used, it will use the point of the block defined last as the center of the support circle with an I radius.

Angle of the straight line.

J...	Angle, in degrees, between the straight line and the abscissa axis.

The angle value will be incremental with respect to the programmed previous angle if a G91 has been programmed earlier.

Intersection number.

[K...]	Choice between the two intersections of the straight line with a circle programmed in the previous block. Optional.

K1 first intersection between the straight line and the circle moving in the direction of the straight line.

K2 second intersection.

If K is not programmed and there are more than one solution, the intersection selected automatically will depend on the previous element.

- If the previous element is a circle, the selected intersection will be the first one in the direction of the straight line.
- If the previous element is a rounding between a circle and the straight line and the straight line being programmed, the selected intersection will depend on the direction of the straight line, on the circle or on the rounding between the straight line and on the circle.

2.3 G820. Define a circle or a point.

A circle or a point may be defined as follows.

- G820 [X...] [Y...] [I...] [Z...] [A...]... [K...]

  Circle with known center and radius.
- G820 [X...] [Y...], [X...] [Y...] I... [K...]

  Circle by two points and known radius.
- G820 [X...] [Y...], [X...] [Y...], [X...] [Y...] [K...]

  Circle by three points

Coordinates of the circle center/point or of the support point of the straight line.

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

Optional. The coordinates are programmed with the name of the axes and the values.

For circles given by two points and a known radius or circles going through three points, the coordinates must always be in absolute Cartesian coordinates. In the rest of the cases, the point can also be indicated in incremental coordinates with G91.

When programming one of the two axes of the plane and leaving the other one out, it will use the coordinate programmed last for the axis that is not programmed. This data may be left out completely if it is identical to those of the last circle programmed in the same profile.

Coordinate axes that do not belong to the reference plane.

[Z...] [A...]	Coordinate axes that do not belong to the reference plane.

In this type of block, the names of all the axes of the machine may be used. In this case, one must indicate the final depth of the axes to be reached at the end of the block.

Circle radius.

[I...]	Circle radius. Optional.

Positive value for counterclockwise and negative for clockwise. If a G91 was programmed earlier, the radius value will be incremental. If the I value is written, the circle is calculated in the current plane; XY plane if in G17, ZX if in G18 and YZ if in G19.

If parameter I is left out, a point will be defined, not a circle. The I value defined in previous blocks will be ignored.

If the point is left out and only G820 I is used, it will use the point of the block defined last as the center of the support circle with an I radius.

Intersection number.

[K...]	Selection of the intersection with an element programmed in the previous block. Optional.

K1 first intersection between the straight line and the circle moving in the direction of the straight line.

K2 second intersection.

If the previous geometric element is a straight line:

K1 chooses the first intersection in the direction of the previous straight line.

K2 chooses the second intersection in the direction of the previous straight line.

If the previous geometric element is a circle:

K1 chooses the intersection to the left of the straight line that joins the center of the previous circle with the center of that circle.

K2 chooses the intersection to the right of the straight line that joins the center of the previous circle with the center of that circle.

If not programmed, by default it assumes K=1.

2.4 G821. Define a chamfer.

A chamfer is defined as follows.

- G821 J...

  J... Size of the chamfer (distance to the vertex).

2.5 G821. Define a rounding or an arc.

A rounding is defined as follows.

- G821 I...

  I... Rounding or arc radius.

Positive rounding or arc value if counterclockwise and negative if clockwise.

2.6 G840. Linear or tangential exit and cancellation of tool radius compensation.

This function is programmed as follows:

- G840 [X...] [Y...] [Z...] [A...] ….[K...] [I...]

  Linear or tangential exit and cancellation of tool radius compensation.

Function G840.

G840 Exit from the profile.

Profile exit point.

[X...] [Y...] [Z...] [A...] Profile exit point. Optional.

Choosing the type of exit from the profile.

[K...] Choosing between two types of exits from profile and canceling tool radius compensations.

K1 automatic exit from the profile with a straight line perpendicular to the last element programmed.

K2 automatic exit from the profile with a semi-circle tangent to the last element programmed.

Leaving K out provides a programmed (not automatic) exit from the profile.

- If K is not programmed, the profile ends in a segment and point, the end of the profile will be perpendicular to the segment at that point. If the profile ends with two segments, the end point of the profile is the intersection point or tangency point between the first and second elements before the G840, tool radius offset.
- If K is not programmed, the last element programmed will not be part of the tool path, but it will only be used to define the intersection point or tangency point with the before-last segment defined. The end of the profile will be on the before-last segment declared.

Radius for tangential exit.

[I...] Radius for tangential exit.

2.7 G841/G842. Begin profile with left-hand or right-hand tool radius compensation.

The beginning of the profile with tool radius compensation may be defined in the following ways.

- G841 [X...] [Y...] [Z...] [A...] … [K...] [I...]

  Begin profile with left-hand tool radius compensation. Function G841 indicates that there is tool radius compensation on the left of the profile (as viewed in the direction of the tool path).

- G842 [X...] [Y...] [Z...] [A...] … [K...] [I...]

  Begin profile with right-hand tool radius compensation. Function G842 indicates that there is tool radius compensation on the right of the profile (as viewed in the direction of the tool path).

Profile entry point.

[X...] [Y...] [Z...] [A...] Profile entry point. Optional.

The point may also be programmed in incremental coordinates with G91.

Choosing the type of entry to the profile.

[K...] Choosing between two types of entries to the profile.

K1 automatic entry to the profile with a straight line perpendicular to the first element programmed.

K2 automatic entry to the profile with a semi-circle tangent to the first element programmed.

Leaving K out provides a programmed (not automatic) entry from the profile.

- If K is not programmed, the profile begins in a segment and a point, the beginning of the profile will be perpendicular to the segment at that point. If the profile begins with two segments, the starting point of the profile is the intersection point or tangency point between the first and second elements after functions G841 and G842, offset to the tool radius.
- If K is not programmed, the first element programmed will not be part of the tool path, but it will only be used to define the intersection point or tangency point with the before-last segment defined. The beginning of the profile will be on the second segment declared.

Radius for tangential entry.

[I...] Radius for tangential entry. Optional.

The radius can also be programmed in incremental coordinates with G91, respect to the radius programmed earlier.

2.8 G850. Cancel rotational offset.

Function G850 cancels the secondary zero offset and returns to the main part zero

2.9 G851. Activate rotational offset.

Rotation and offset are set as follows.

- G851 [X...] [Y...] [J...] [K...]

  Activate rotational offset.

With G851, it is possible to set an unlimited number of secondary of zero offsets or rotate them with respect to part zero or with respect to the last secondary offset programmed. The whole program can also be rotated with respect to any point.

Rotation and offset.

[X...] [Y...]	Coordinates of the new zero offset with respect to the active zero offset or point around which the program is to be rotated.
[J...]	Angle between the X axis and the new zero offset and the X axis of the active zero offset, or program rotation angle.
[K]	K1: Rotational offset around the part zero (default option).
	K2: Rotational offset around the last secondary zero offset programmed.
	K3: Rotation around the programmed point.

3 ISO FUNCTIONS.

ISO functions ISO (G801, G802, G803, G808, G809, G831, G832 and G833) may be used to define a profile through the segments and arcs that make it up in a similar way as functions G01, G02, G03, G08, G09 but with more options. Tool paths are programmed using straight or curved segments that start from the end point of the previous segment and finish at the point programmed in that segment. This group of functions offer the user the possibility to combine segments or arcs with straight lines and circles.

The characteristics of these functions are the following.

- The coordinates can be programmed in inches, millimeters or with a scaling factor.
- The data that is left out is recovered from the previous data only for G801, G802, G803. G808 and G809 require defining the points. For G831, G832 and G833 the data that is left will be calculated according to the programmed data.
- In arcs, the radius is defined with I1= and the direction with G802, G832 (clockwise) or G803, G833 (counterclockwise).
- By default, the center of the arcs will be in incremental coordinates referred to the end point.

3.1 G801. Define a ray or segment.

A ray or segment may be defined with G801 as follows.

- G801 [X...] [Y...] J [K...]

  Ray that ends at a point and at a given angle.

- G801 J

  Ray with starting point at the previous segment and at a given angle.

- G801 [X...] [Y...]

  Segment that ends at a point(same as G1) or end point of previous ray.

- G801

  End point of they ray previously defined with G811 or G813.

Coordinates of the end point of the ray (modes 1 and 3).

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

The end point of the segment may be programmed in either absolute or incremental (Cartesian or Polar) coordinates. If a G91 has been programmed before the G801, the coordinates of the point will be considered incremental with respect to the last programmed point.

Defining the segment correctly requires indicating the coordinates of the end point and the angle of the ray; if one of the coordinates is left out, it uses the last coordinate programmed earlier.

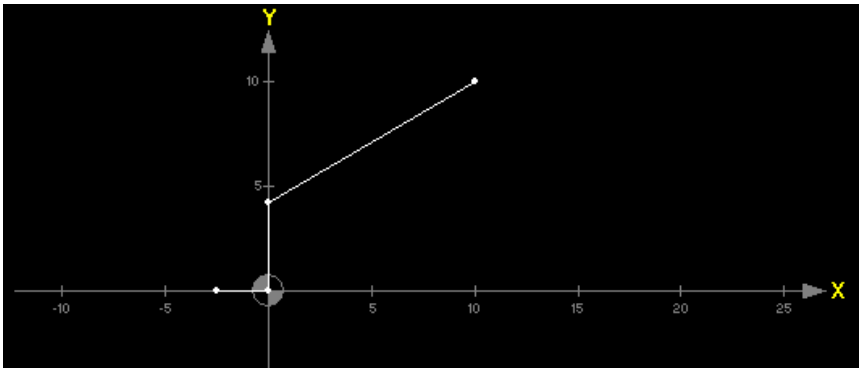
Angle.

J...	Angle of the ray (with G91, incremental with respect to the previous programmed angle).

Intersection number.

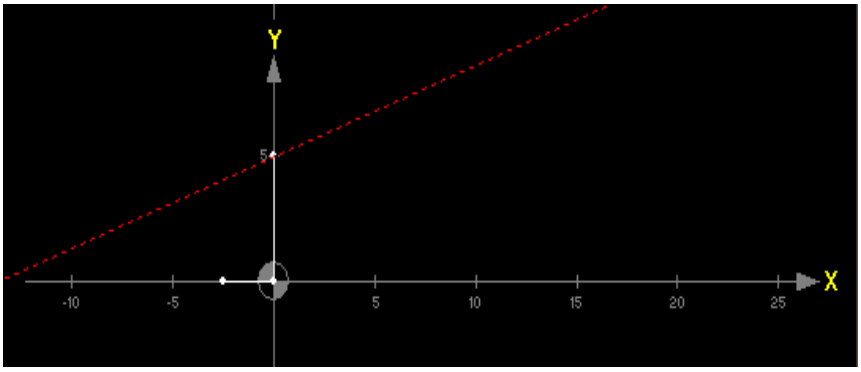
[K...]	Intersection number with the previous element.

Example mode 1: G801 [X...] [Y...] J [K...]



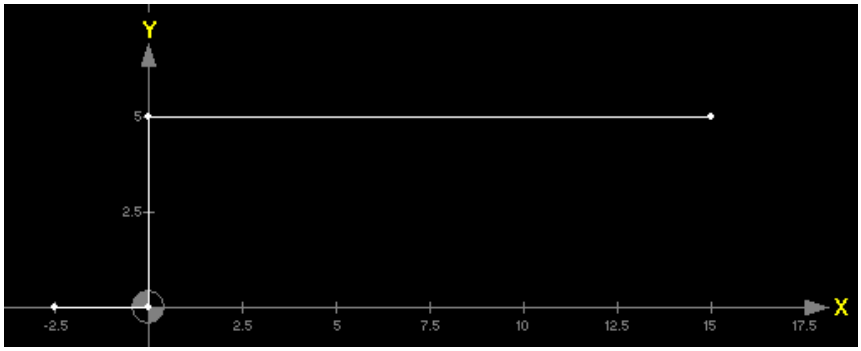

```
G0 X-2.5 Y0
G841 K1
G813 X0 J90
G801 X10 Y10 J30
```

Example mode 2: G801 J




```
G0 X-2.5 Y0
G841 K1
G813 X0 J90
G801 X0 Y5
G801 J20
```

Example mode 3: G801 [X...] [Y...]




```
G0 X-2.5 Y0
G841 K1
G813 X0 J90
G801 X0 Y5
G801 X15 Y5
```

3.2 G802/G803. Define a circle of an arc.

A circle or an arc may be defined as follows.

- G802/G803 [X...] [Y...] [I...] [J...] [K...]

  Clockwise/counterclockwise circle or arc that begins at the end point of the previous element or at the intersection with the previous element and ends at the programmed point and with the given center.

- G802/G803 [X...] [Y...] I1=...

  Clockwise/counterclockwise circle or arc that begins at the end point of the previous element and ends at the programmed point and with the given center.

- G802/G803 [X...] [Y...]

  Arc that ends at a point. When programming both coordinates, it must be a valid point; if only one is programmed, the other one is already calculated.

- G802/G803 [I...] [J...]

  Circle with starting point at the previous end point and with the given center.

Coordinates of the end point of the circle or arc (modes 1, 2 and 3).

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

Center of the circle (modes 1 and 4).

[I...] [J...]	Coordinates of the center of the circle or of the arc.

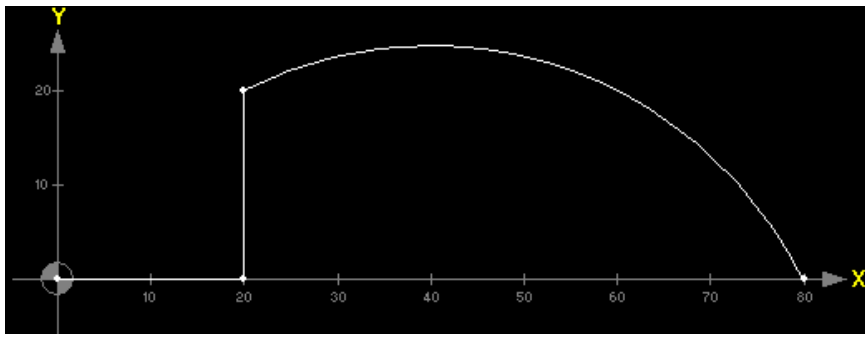
The end point of the arc and the center may be programmed in either absolute or incremental (Cartesian or Polar) coordinates. If one of the coordinates is left out, it uses the last coordinate programmed earlier. At least one of the coordinates must be programmed. If a G91 has been programmed before the G802, the coordinates of the point will be considered incremental with respect to the previous programmed point.

By default, the arc center I J will be in incremental referred to the starting point of the arc and it will be necessary to program a G06 in the block to be considered absolute or a G262.

Radius of the circle (mode 2).

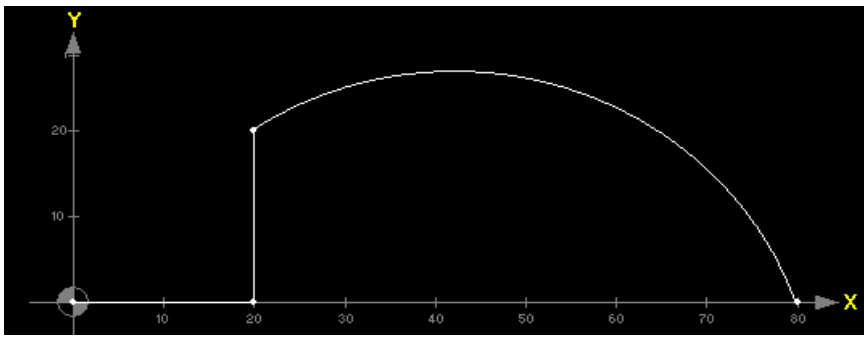
I1=...	Radius of the circle (with G91, incremental with respect to the previous programmed radius).
[K...]	Intersection number with the previous element.

Example mode 1: G802/G803 [X...] [Y...] [I...] [J...] [K...]



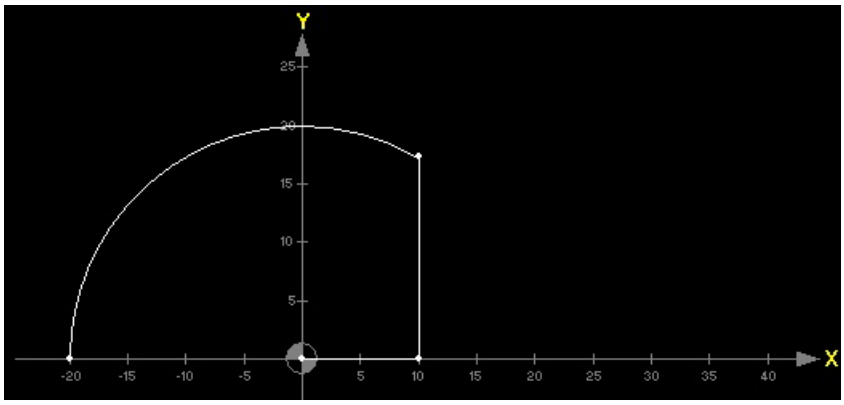

```
G0 X0 Y0
G841 K1
G813 X20 J90
G802 G06 X80 Y0 I40 J-20 K2
```

Example mode 2: G802/G803 [X...] [Y...] I1=... [K...]



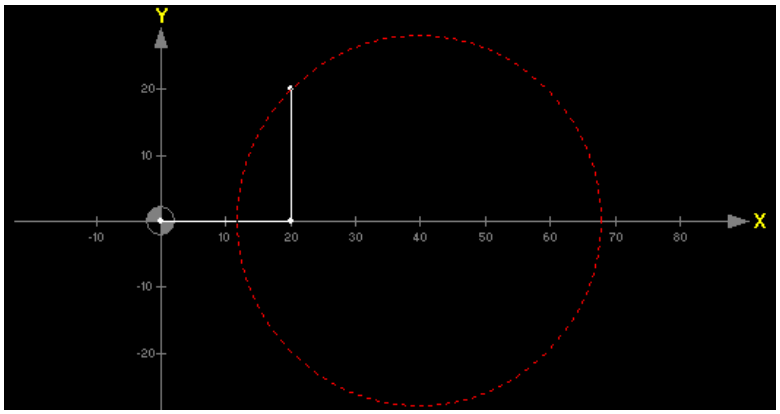

```
G0 X0 Y0
G841 K1
G813 X20 J90
G801 Y20
G802 X80 Y0 I1=40
```

Example mode 3: G802/G803 [X...] [Y...]




```
G0 X0 Y0
G841 K1
G813 X10 J90
G820 X0 Y0 I20
G803 X-20 Y0
```

Example mode 4: G802/G803 [I...] [J...]




```
G0 X0 Y0
G841 K1
G813 X20 J90
G801 Y20
G802 G06 I40 J0
```

3.3 G808. Arc tangent to previous path.

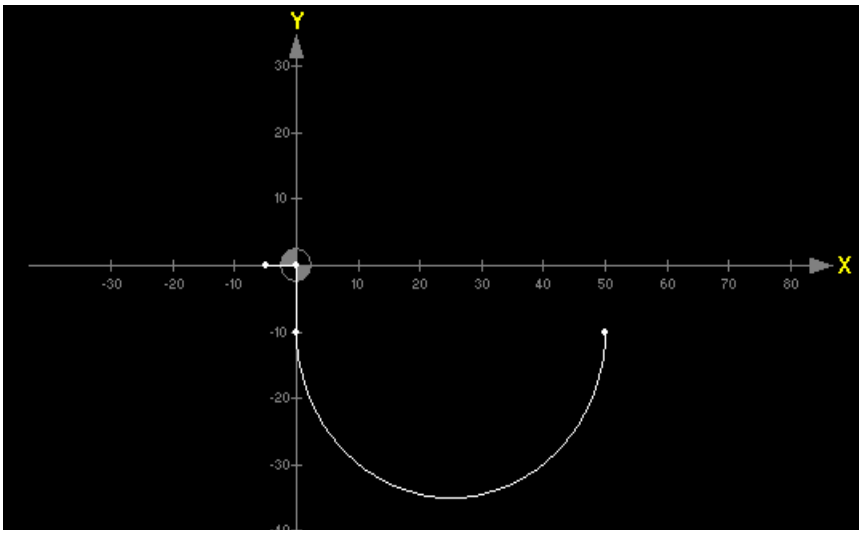
An arc tangent to the previous path is defined with the end point of the arc.

- G808 X... Y...

Coordinates of the final point of the circle or of the arc.

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

Both coordinates are required. If a G91 has been programmed before the G808, the coordinates of the point will be considered incremental with respect to the previous programmed point.




```
G0 X-5 Y0
G841 K1
G813 X0 J-90
G801 Y-10
G808 X50 Y-10
```

3.4 G809. Arc going through three points.

An arc that begins at the end point of the previous element and goes through the programmed intermediate point and end point is defined as follows.

- G809 X... Y... I... J...

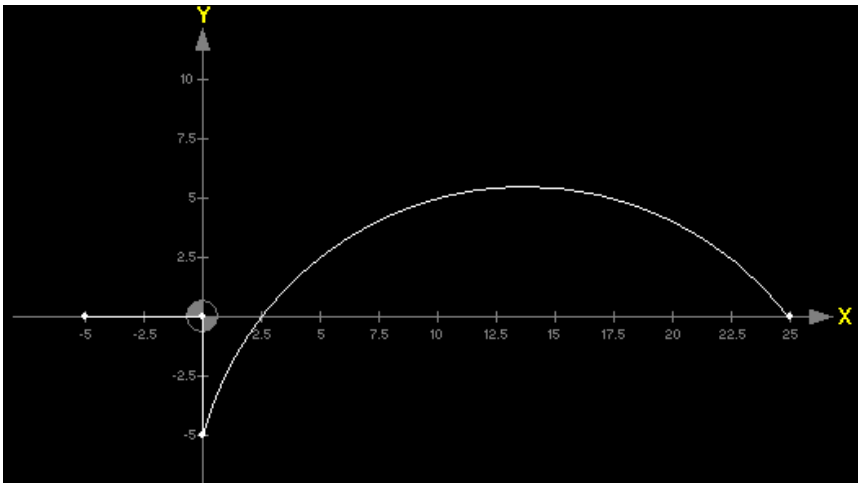
Coordinates of the end point of the arc

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

Intermediate point of the arc (mode 1).

I... J...	Coordinates of an intermediate point of the arc.

Both coordinates of each point must be programmed. If a G91 has been programmed before the G809, the coordinates of the end point and intermediate point will be considered incremental with respect to the previous programmed point.




```
G0 X-5 Y0
G841 K1
G813 X0 J-90
G801 Y-5
G809 X25 Y0 I10 J5
```

3.5 G831. Define a ray or segment tangent to the previous element.

A ray or segment tangent to the previous element is done as follows.

- G831 [X...] [Y...] [J...] [K...]

  Ray tangent to the previous element that ends at the programmed point and has an angle J.

Coordinates of the end point of the ray.

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

The end point of the segment may also be programmed in incremental coordinates with G91. In the case of tangent elements such as G831, G832 and G833, the missing data will calculated considering the tangency point with the previous element and the rest of the data provided by the user.

Angle of the ray.

[J...]	Angle of the ray.

The angle value will be incremental if a G91 has been programmed earlier.

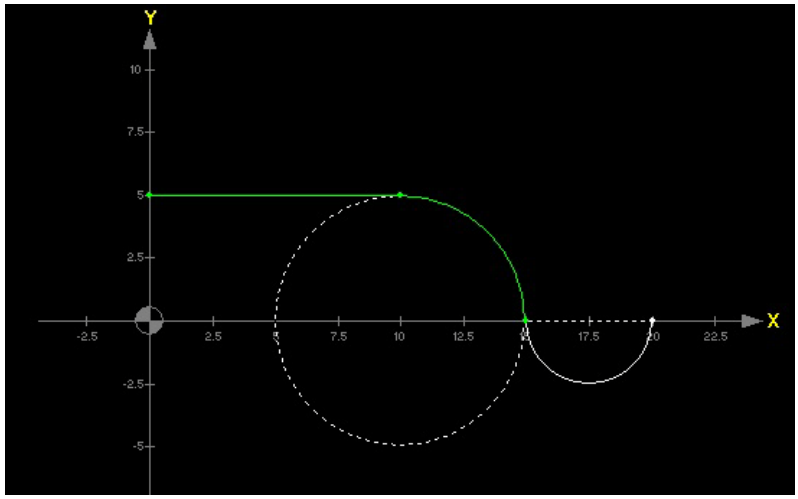
Tangency solution number.

[K...]	Chosen solution number. Tangency point with previous element

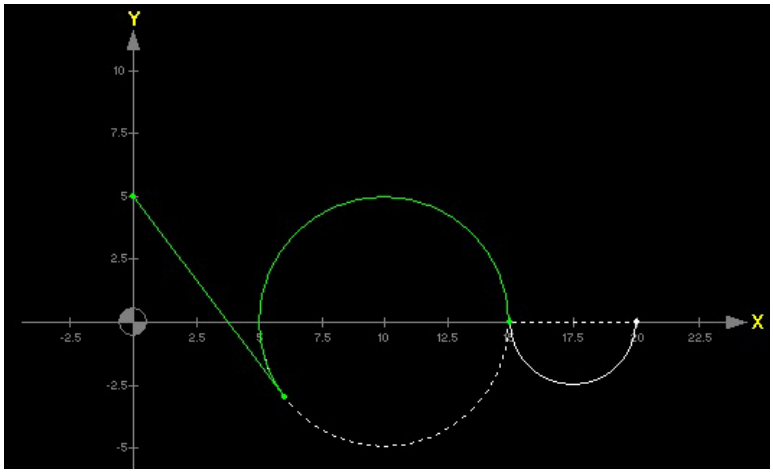
When there are more tan one solution, the different solutions will be displayed graphically.

Example G831 [X...] [Y...] [K...]

Known data; end point and tangency with previous element.



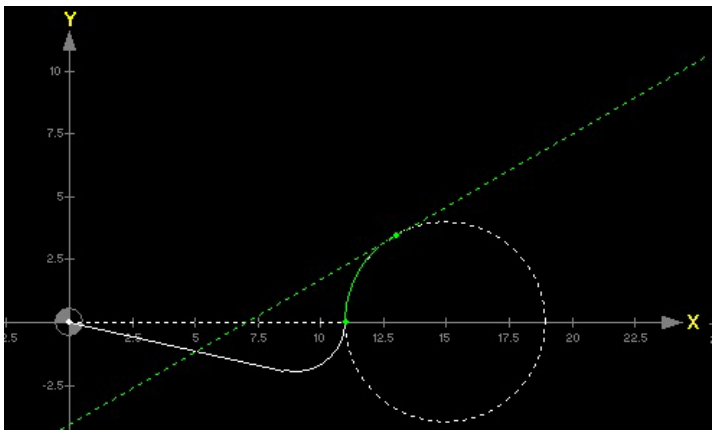

```
G0 X20 Y0
G842 K2
G820 X10 I5
G831 X0 Y5 K1
```



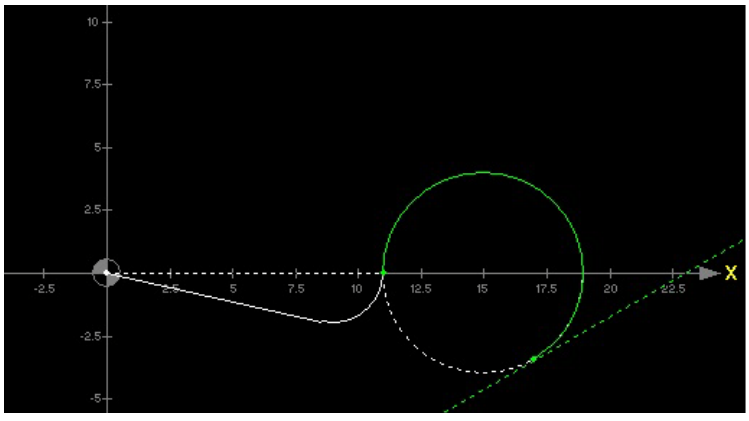

```
G0 X20 Y0
G842 K2
G820 X10 I5
G831 X0 Y5 K2
```

Example G831 [J...] [K...]

Known data; angle of the straight line and tangency point with the previous element.




```
G0 X0 Y0
G841 K2 I2
G820 X15 Y0 I-4
G831 J30 K1
```




```
G0 X0 Y0
G841 K2 I2
G820 X15 Y0 I-4
G831 J30 K2
```

3.6 G832/G833. Define a circle or arc tangent to the previous element.

A circle or arc tangent to the previous element is defined as follows.

- G832/G833 [X...] [Y...] [I...] [J...] [I1=...] [K...]

Coordinates of the end point of the arc

[X...] [Y...]	Cartesian coordinates in G17.
[Z...] [X...]	Cartesian coordinates in G18.
[Y...] [Z...]	Cartesian coordinates in G19.
[Q...] [R...]	Polar coordinates.

If a G91 has been programmed earlier, the coordinates of the point will be considered incremental with respect to the ones programmed earlier. The missing data will calculated considering the tangency point with the previous element and the rest of the data provided by the user.

Incremental coordinates of the center of the circle.

[I...] [J...]	Circle center coordinates.

By default, the center coordinates will be incremental; programming them as absolute requires a G06 in the block or a G262.

Tangency solution number.

[K...]	Chosen solution number. Tangency point with previous element.

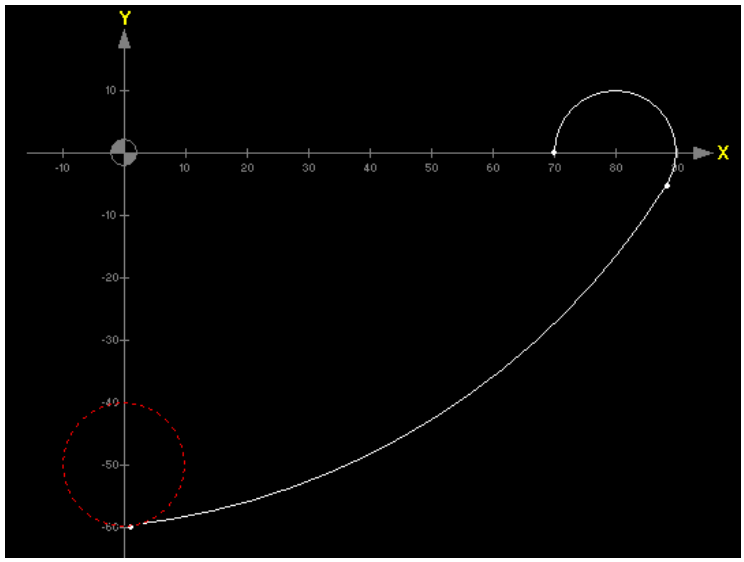
When there are more tan one solution, the different solutions will be displayed graphically.

Circle radius.

[I1=...]	Circle radius. Optional.

Positive value for counterclockwise and negative for clockwise. If a G91 was programmed earlier, the radius value will be incremental.

Examples G832 I1= / G832 I J I1=




```
X70 Y0
G842 K2
G820 X80 Y0 I-10
G832 I1=120 K1
G832 G06 I0 J-50 I1=10
```

4 AUXILIARY FUNCTIONS.

Some types of auxiliary functions may be inserted into a ProGTL3 profile. Auxiliary functions may be programmed alone in the block or may be added to profile defining blocks. These auxiliary functions will be executed when executing the movement programmed in the same blocks.

The possible auxiliary functions are the following:

- F... Work feedrate.
- S... Spindle turning speed.
- M... Call to an M function of the PLC.
- H... Call to an H function of the PLC.

F..., S...

These functions may be written in the ProGTL3 block as well as in a single block. If the instruction is written in the ProGTL3 block, it is applied at the beginning o fthe movement indicated in the block.

M..., H...

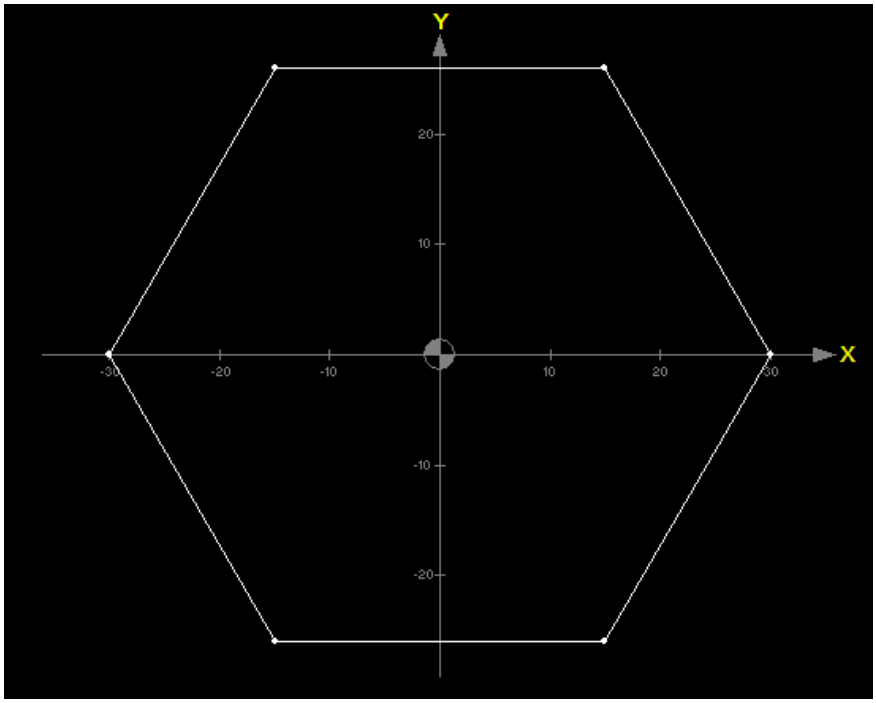
These functions may be written in the ProGTL3 block as well as in a single block. If the command is written in the ProGTL3 block, it will be executed by the PLC and it will be applied before or after the movement depending on the type of M and on how the CNC has been configured by the machine manufacturer (OEM).

G91

To program in incremental coordinates. The effect of G91 on ProGTL3 functions is described, case by case in each G of the ProGTL3.

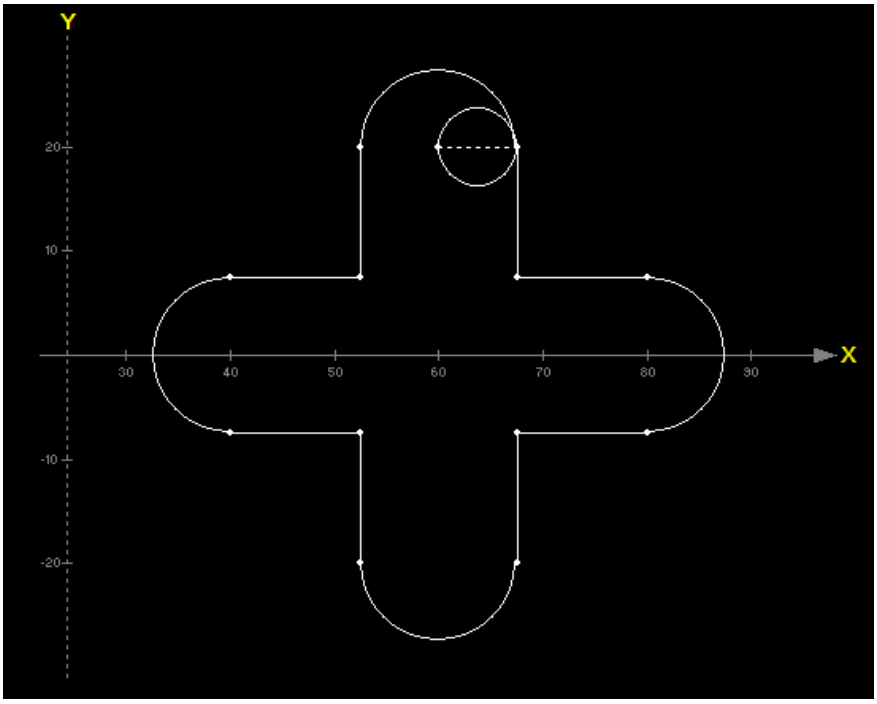
5 PROGRAMMING EXAMPLES.

Example 1.



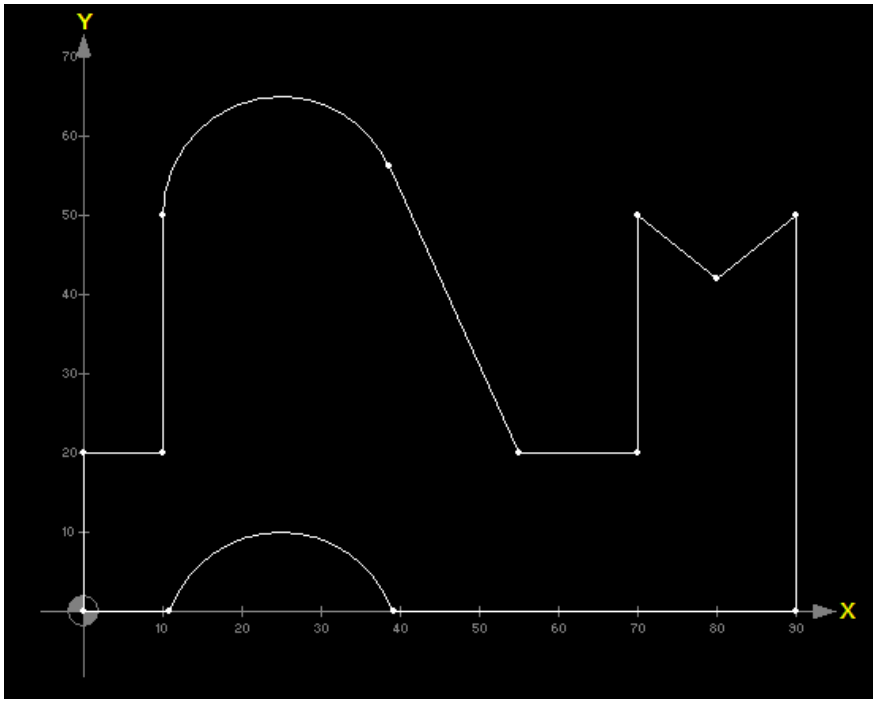

```
G0 X30 Y0
G841 K1
G810 X30 Y0 ;1
G811 Q60 R30 ;2
G811 Q120 R30 ;3
G811 X-30 Y0  ;4
G811 Q-120 R30 ;5
G811 Q-60 R30 ;6
G811 X30 Y0;7
G840 Q0 R30 K1
```

Example 2.



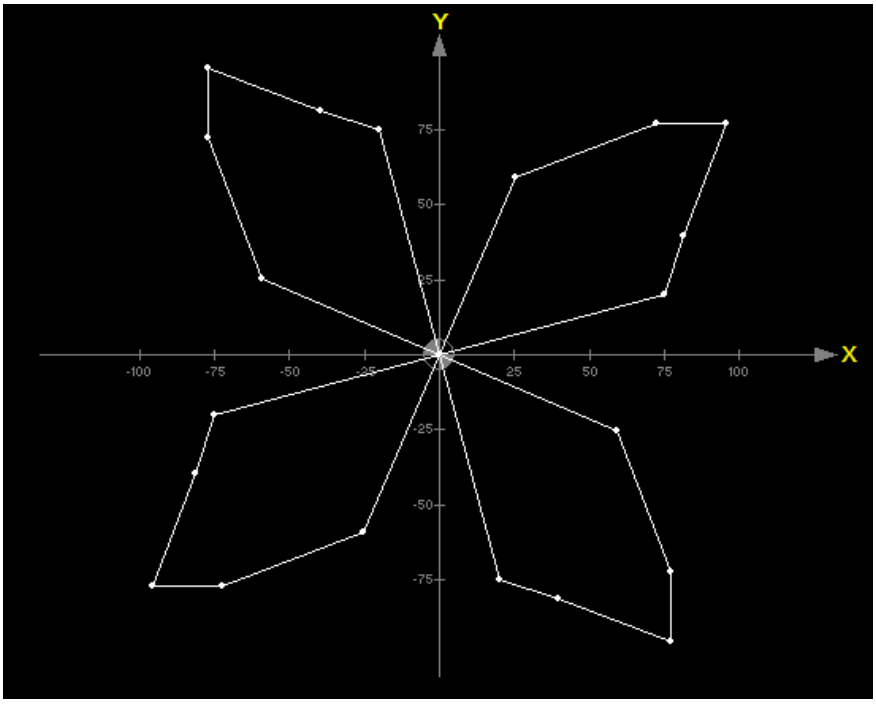

```
G851 X60 Y0
G0 X0 Y20
G841 K2 I3.75
G820 I7.5
G813 X-7.5 J-90
G813 Y7.5 J180
G820 X-20 Y0 I7.5
G813 Y-7.5 J0
G813 X-7.5J-90
G820 X0 Y-20 I7.5
G813 X7.5 J90
G813 Y-7.5J0
G820 X20 Y0 I7.5
G813 Y7.5 J 180
G813 X7.5 J90
G840 X0 Y20 K2 I3.75
```

Example 3.



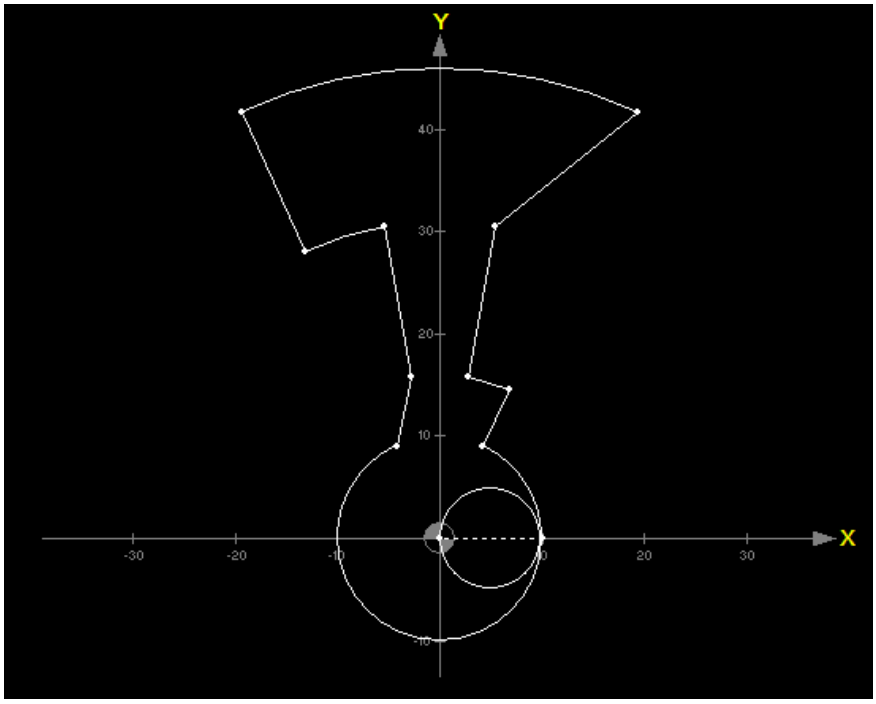

```
G0 X0 Y0
G841 K1
G813 Y0 J0
G820 X25 Y-5 I-15
G813 Y0 J0 K2
G813 X90 J90
G810 X90 Y50
G811 X80 Y42
G811 X70 Y50
G813 X70 J-90
G813 Y20 J180
G810 X55 Y20
G811 X25 Y50 I15
G820 X25 Y50 I15
G813 X10 J-90
G813 Y20J180
G813 X0J-90
G840 X0 Y0
```

Example 4.



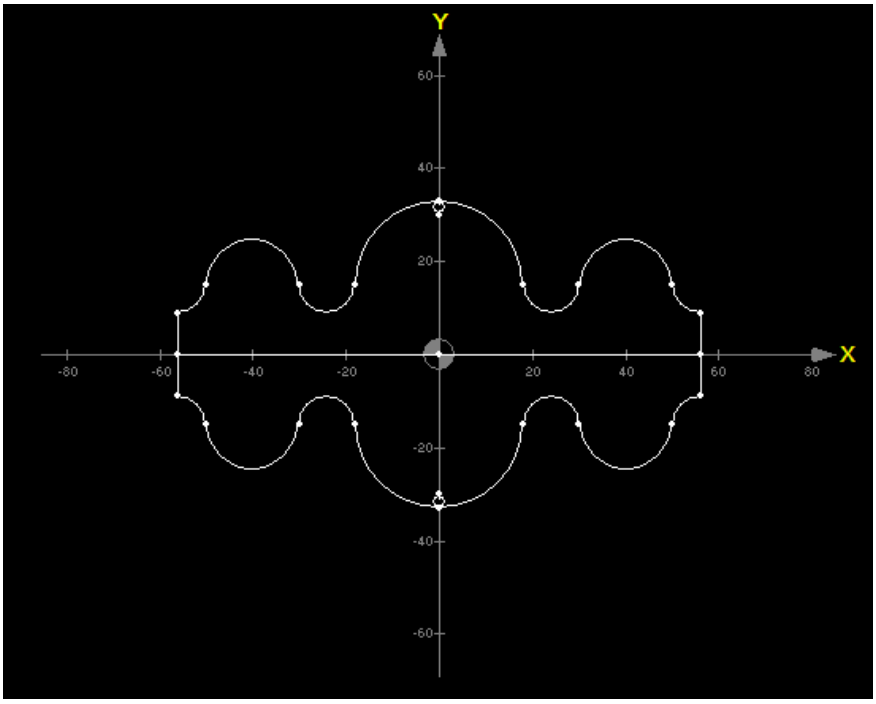

```
G0 Y0 X0
G841
G810 X0 Y0
G811 X25.4078 Y59.2849
G813 X25.4078 Y59.2849 J21
G813 Y77.2033 J0
G813 X95.4078 Y77.2033 J249
G810 X81.073 Y39.86
G811 X75 Y20
G810 X75 Y20
G811 X0Y0
G840 X0 Y0
(----------)
G851 X0 Y0 J90
G0 Y0 X0
G841
G810 X0 Y0
G811 X25.4078 Y59.2849
G813 X25.4078 Y59.2849 J21
G813 Y77.2033 J0
G813 X95.4078 Y77.2033 J249
G810 X81.073 Y39.86
G811 X75 Y20
G810 X75 Y20
G811 X0Y0
G840 X0 Y0
(----------)
G851 J180
G0 Y0 X0
G841
G810 X0 Y0
G811 X25.4078 Y59.2849
G813 X25.4078 Y59.2849 J21
G813 Y77.2033 J0
G813 X95.4078 Y77.2033 J249
G810 X81.073 Y39.86
G811 X75 Y20
G810 X75 Y20
G811 X0Y0
G840 X0 Y0
(----------)
G851 J-90
G0 Y0 X0
G841
G810 X0 Y0
G811 X25.4078 Y59.2849
G813 X25.4078 Y59.2849 J21
G813 Y77.2033 J0
G813 X95.4078 Y77.2033 J249
G810 X81.073 Y39.86
G811 X75 Y20
G810 X75 Y20
G811 X0Y0
G840 X0 Y0
```

Example 5.



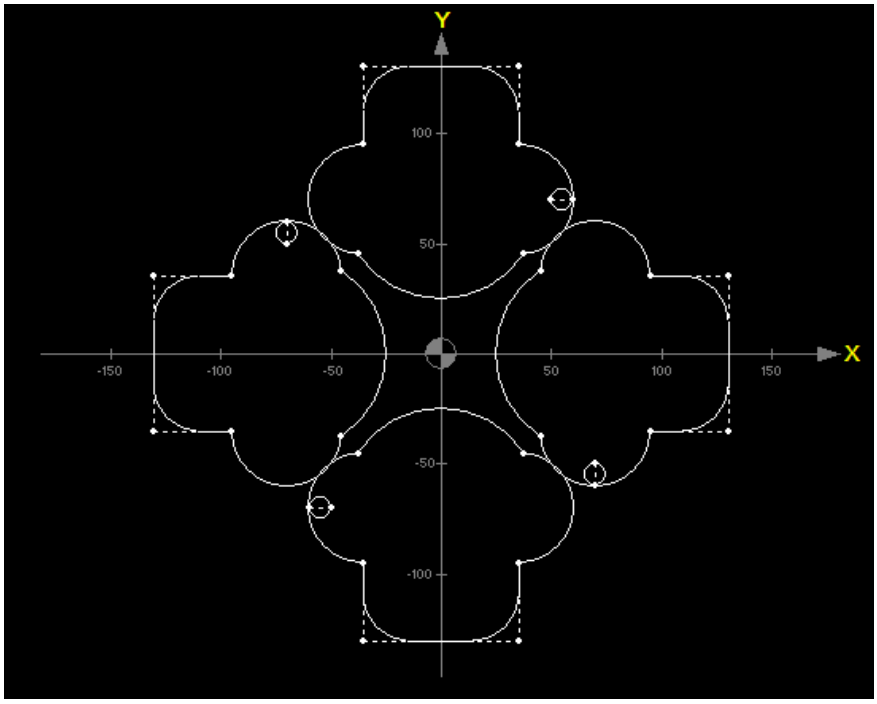

```
G0 X0 Y0
G841 K2
G820 I10
G813 X0 Y0 J65 K2
G810 Q65 R16
G811 Q80 R016
G813 Q80 R31 J80
G810 Q80 R31
G811 Q65 R46
G820 X0 Y0 I46 K2
G813 Q115 R46 J115 K2
G820 X0 Y0 I-31
G813 Q100 R31 J100 K2
G810 Q100 R16
G811 Q115 R10
G820 X0 Y0 I10
G840 X0 Y0 K2
```

Example 6.



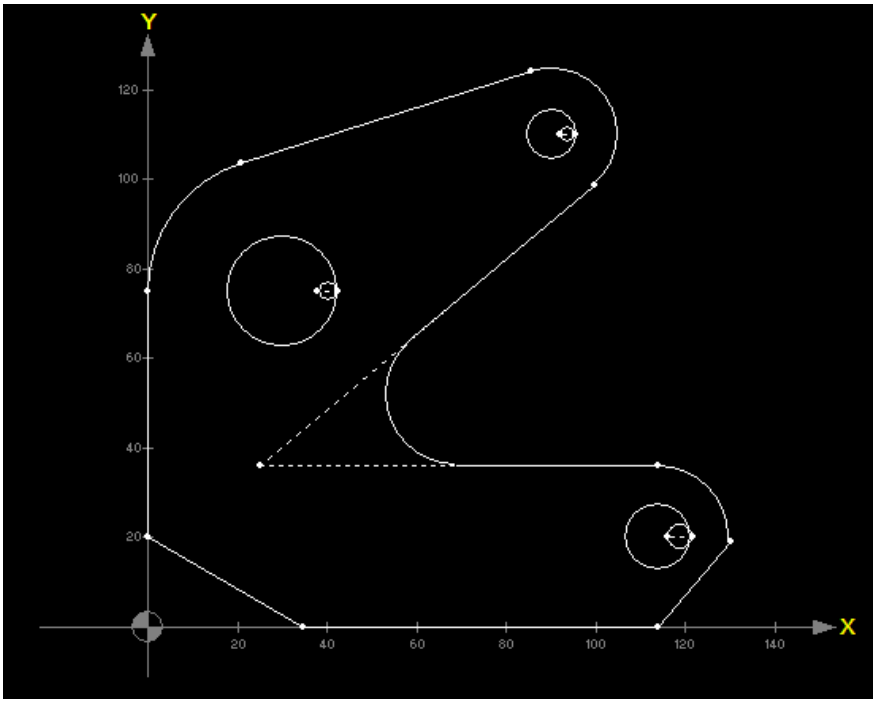

```
G0 X0 Y0
(----------------------)
G851 X0 Y15
G0 X0 Y15
G841 K2
G820 X0 Y0 I18
G820 X-24 Y0 I-6
G820 X-40 Y0 I10
G820 X-56 Y0 I-6
G813 X-56 J-90 K2
G813 Y-15 J0
G813 X56 J90
G820 X56 Y0 I-6
G820 X40 Y0 I10
G820 X24 Y0 I-6
G820 X0 Y0 I18
G840 X0 Y15 K2
(----------------------)
G851 X0 Y-15 J180
G0 X0 Y15
G841 K2
G820 X0 Y0 I18
G820 X-24 Y0 I-6
G820 X-40 Y0 I10
G820 X-56 Y0 I-6
G813 X-56 J-90 K2
G813 Y-15 J0
G813 X56 J90
G820 X56 Y0 I-6
G820 X40 Y0 I10
G820 X24 Y0 I-6
G820 X0 Y0 I18
G840 X0 Y15 K2
```

Example 7.



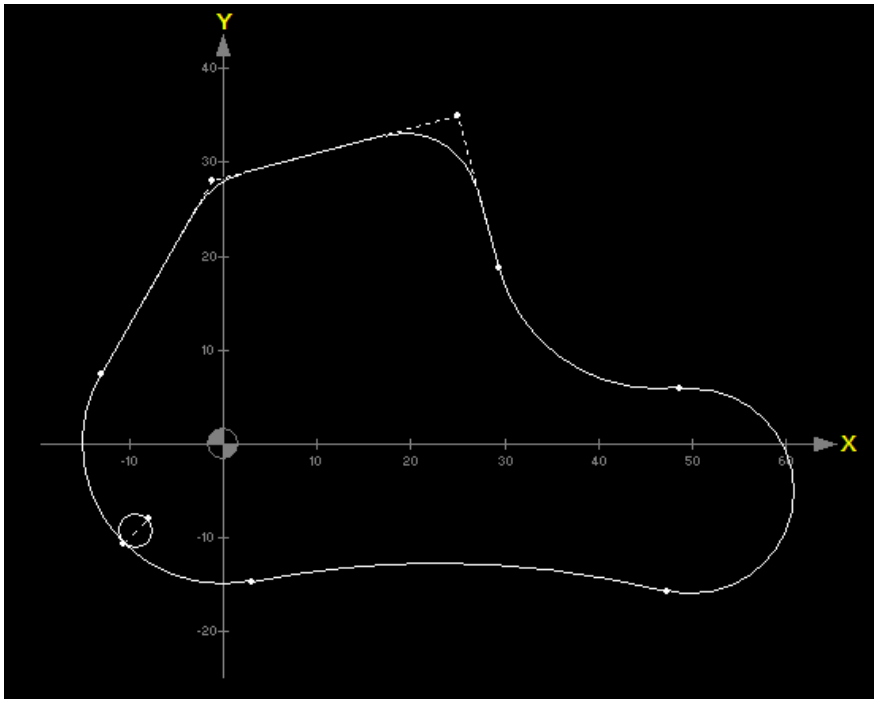

```
G851 X0 Y70
G0 X50 Y0
G841 K2
G820 X35 Y0 I25
G813 X35 Y25 J90 K2
G821 I20
G813 X0 Y60 J180
G821 I20
G813 X-35 Y25 J-90
G820 X-35 Y0 I25
G820 X0Y0 I45 K2
G820 X35 Y0 I25 K2
G840 X50 Y0 K2
(----------)
G851 X-70 Y0 J90
G0 X50 Y0
G841 K2
G820 X35 Y0 I25
G813 X35 Y25 J90 K2
G821 I20
G813 X0 Y60 J180
G821 I20
G813 X-35 Y25 J-90
G820 X-35 Y0 I25
G820 X0Y0 I45 K2
G820 X35 Y0 I25 K2
G840 X50 Y0 K2
(----------)
G851 X0 Y-70 J180
G0 X50 Y0
G841 K2
G820 X35 Y0 I25
G813 X35 Y25 J90 K2
G821 I20
G813 X0 Y60 J180
G821 I20
G813 X-35 Y25 J-90
G820 X-35 Y0 I25
G820 X0Y0 I45 K2
G820 X35 Y0 I25 K2
G840 X50 Y0 K2
(----------)
G851 X70 Y0 J-90
G0 X50 Y0
G841 K2
G820 X35 Y0 I25
G813 X35 Y25 J90 K2
G821 I20
G813 X0 Y60 J180
G821 I20
G813 X-35 Y25 J-90
G820 X-35 Y0 I25
G820 X0Y0 I45 K2
G820 X35 Y0 I25 K2
G840 X50 Y0 K2
```

Example 8.



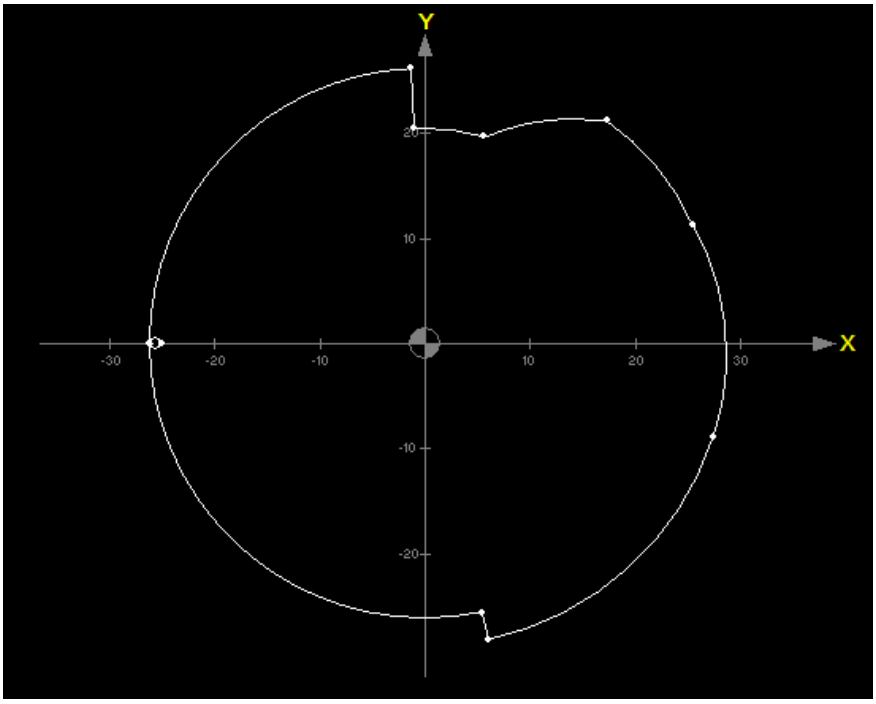

```
;
G0 X0 Y20
G841
G813 X0 J90
G820 X30 Y75 I-30
G811 X90 Y110 I-15
G820 X90 Y110 I-15
G813 X90 Y110 I-15 J220
G821 I16
G813 Y36 J0
G820 X114 Y20 I-16
G813 X114Y0 J230
G813 Y0 J180
G813 X0 Y20 J150
G840 X0 Y20
;
G0 X38 Y75
G841 K2
G820 X30 Y75 I12.5
G840 X38 Y75 K2
;
G0 X92 Y110
G841 K2
G820 X90 Y110 I5.5
G840 X92 Y110 K2
;
G0 X116 Y20
G841 K2
G820 X114 Y20 I7.5
G840 X116 Y20 K2
```

Example 9.




```
G0 X-8 Y-8
G841 K2
G820 X0 Y0 I15
G821 I-100
G820 X50 Y-5 I11
G821 I-17.5
G813 X25 Y35 J-75
G821 I8
G813 X25 Y35 J195
G821 I8
G813 X0 Y0 I15 J240
G820 X0 Y0 I15
G840 X-8 Y-8 K2
```

Example 10.




```
G0 X-25 Y0
G841 K2
G820 X0 Y0 I26.25
G813 X0 Y0 J-78 K2
G820 X0 Y0 I28.85
G820 X3.1385 Y-1.0198 I25.55
G820 X3.7974 Y1.6907 I23.75 K2
G820 X14.0917 Y0 I21.44
G820 X0 Y0 I20.5 K2
G813 X0 Y0 J93 K2
G820 X0 Y0 I26.25
G840 X-25 Y0 K2
```

