vhf
CREATING PERFECTION

Command set for control type CNC_X

for post-processor development for vhf milling machines of the X series

Content

1. General

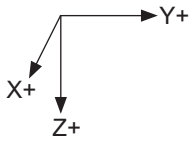
This documentation contains the most important information for creating a post processor to control a vhf portal milling machine with 3 axes (X, Y and Z axes). The command formats described here are designed for the CNC_X control.

Machining commands are saved in an output file. The output file is saved and managed on an internal computer of the machine. The machine is operated with an Android app (“CNC Pilot”) specially developed by vhf camfacture AG.

2. Arrangement of the axes

In vhf portal milling machines with 3 axes, the X and Y axes are horizontally at 90 ° to each other and form the plane of the table. The Z axis is perpendicular to the X and Y axes at a 90 ° angle. It moves perpendicular to the table. The machine zero point is located in the rear, left, upper corner of the machining area. Starting from their machine zero point, all axes are traversed in a positive direction.

X axis	Back to front
Y axis	Left to right
Z axis	Top to bottom



3. Job zero point

When creating a job, select the Z zero plane in your CAM program so that it is on the upper surface of the workpiece.

- Z movements away from the workpiece take place as a negative Z value.
- Z movements into the workpiece take place as a positive Z value.

4. Resolution of distance and traversing speed

The distances of all axes are to be resolved in 1/1,000 mm (1 µm).

PA10000;	Distance in the X axis: 10,000 µm = 10 mm = 1 cm

The travel speeds of all axes are to be resolved in 1/1000 mm/s (1 µm/s).

VS25000;	Axis speed: 25,000 µm/s = 25 mm/s = 1.5 m/min

5. Circle, helix and spline commands

Due to the high line processing speeds, circle, helix and spline commands are not available. Therefore, the lines in the post processor must be resolved with very fine tolerance values of 0.01 mm.

6. Control commands

6.1 General

Character encoding

Except in comments, all characters must contain US-ASCII. Any Unicode characters can appear in comments. UTF-8 is generally accepted as the character set for data exchange.

There are only integers.

Space characters (US-ASCII character 32), horizontal tab (US-ASCII character 9), line break (US-ASCII character 10), carriage return (US-ASCII character 13) are permitted as space characters.

It is possible to insert comments at any point in a milling program. A comment starts with a single slash “/” (US-ASCII character 47) and ends with a backslash “\” (US-ASCII character 92). There are no nested comments, i.e. a “/” within a comment does not begin a comment in the comment. The direct use of "\" within a comment is not possible.

Recommendation: For better readability, it is recommended to insert a line break (US-ASCII character 10) after each command.

All control commands must be terminated with a semicolon [;] in order to execute them. Comments are listed with a leading slash [/] and a closing backslash [\]. In commands with multiple values, these are separated by a comma [,].

Control commands	Comment (exemplary)	Explanation
T1;	Fetch a tool	Tool 1 is fetched
T0;	Put down the tool	Previously fetched tool is stored
OS10,1;	Switch on the output	Control output 10 is activated
OS10,0;	Switch off the output	Control output 10 is deactivated
RVS20000;	Sets the spindle speed in rpm and switches the spindle on	Spindle speed = 20,000 rpm
RVS0;	Turns off the spindle	Spindle speed = 0 rpm
VS5000;	Defines the feed rate in 1/1,000 mm/s	Feed = 5 mm/s
PA10000,10000,5000;	Interpolated movement of the machine to given position in 1/1,000 mm/s	Position: X = 10 mm, Y = 10 mm, Z = 5 mm
GA10000,10000,5000;	Moving the machine in rapid traverse to given position in 1/1,000 mm/s	Position: X = 10 mm, Y = 10 mm, Z = 5 mm

6.2 Definable control commands

Depending on the equipment of the vhf portal milling machine used, there are also controllable outputs. The programmable outputs on the X machine series are:

Output	Control commands	Comment (exemplary)	Explanation
8	OS8,0;	Minimum quantity lubrication	Deactivates the minimum quantity lubrication
	OS8,1;	Minimum quantity lubrication	Activates the minimum quantity lubrication
10	OS10,0;	External 230 V socket (vacuum cleaner)	Deactivates the external socket to which the vacuum cleaner is plugged in, which sucks up the chips.
	OS10,1;	External 230 V socket (vacuum cleaner)	Activates the external socket to which the vacuum cleaner is plugged in, which sucks up the chips.
23	OS23,0;	Air cooling	Deactivates air cooling
	OS23,1;	Air cooling	Activates air cooling

Depending on the machining strategy, these outputs are usually activated immediately before or after the spindle is started and deactivated immediately before or after the spindle is stopped.

6.3 Traversing control commands

There are two different control commands for moving the machine:

GA	For moving the machine in rapid traverse with maximum axis speed
PA	For moving the machine with a defined feed rate Before the first PA command, the feed rate must be defined using a VS command.

A move command is structured as follows:

GA	40000	,	30000	,	-2000	;
Rapid traverse	X position	Delimiter	Y position	Delimiter	Z position	Confirmation of command

If a traversing command is to be given with a defined feed rate, a feed rate must be set beforehand:

VS35000;	Feed in the X, Y and Z axes is until the next change in feed: V_{xyz} = 35mm/s
PA10000,10000.5000;	Machine moves with a defined feed rate to: X = 10 mm, Y = 10 mm und Z = 5 mm

If only the Y or Z axis is to be traversed, a [,] must be used as a placeholder:

PA20000;	Machine moves with a defined feed rate to: X = 20 mm and remains in the Y-axis and the Z-axis in the position where it was before.
PA,10000;	Machine moves with a defined feed rate to: Y = 10 mm and remains in the X-axis and the Z-axis in the position where it was before.
PA,,5000;	Machine moves with a defined feed rate to: Z = 5 mm and remains in the X-axis and the Y-axis in the position where it was before.

6.4 Start command set

The following command sequence should be adhered to at the beginning of every job.

Control commands	Abstract notation	Explanation
T1;	T<p>;	Tool 1 is fetched
GA0,0;	GA<p1,p2>;	The machine moves in rapid traverse to the set job zero point Position: X = 0 mm and Y = 0 mm
GA,,-2000;	GA,,<p>;	The machine moves in rapid traverse to the set safety distance position: X = 0 mm, Y = 0 mm, Z =- 2 mm
OS10,1;	OS<p>,1;	Control output number 10 is activated "external 230 V socket (vacuum cleaner)"
OS8,1;	OS<p>,1;	Control output number 8 is activated "minimum quantity lubrication"
RVS25000;	RVS<p>;	The spindle speed is set to 25,000 rpm and the spindle is switched on

6.5 Tool change command set

If a tool change is carried out during an order, the following command sequence should be adhered to.

Control commands	Abstract notation	Explanation
RVS0;	RVS<p>;	The spindle speed is set to 0 rpm and the spindle is switched off
OS8,0;	OS<p>,0;	Control output number 8 is deactivated "minimum quantity lubrication"
OS10,0;	OS<p>,0;	Control output number 10 is deactivated "external 230 V socket (vacuum cleaner)"
T2;	T<p>;	Current tool is deposited and tool 2 is fetched
GA0,0;	GA<p1,p2>;	The machine moves in rapid traverse to the set job zero point Position: X = 0 mm and Y = 0 mm
GA,,-2000;	GA,,<p>;	The machine moves in rapid traverse to the set safety distance position: X = 0 mm, Y = 0 mm, Z = -2 mm
OS10,1;	OS<p>,1;	Control output number 10 is activated "external 230 V socket (vacuum cleaner)"
OS8,1;	OS<p>,1;	Control output number 8 is activated "minimum quantity lubrication"
RVS25000;	RVS<p>;	The spindle speed is set to 25,000 rpm and the spindle is switched on

6.6 End command set

The following command sequence should be adhered to when each job is completed.

Control commands	Abstract notation	Explanation
RVS0;	RVS<p>;	The spindle speed is set to 0 rpm and the spindle is switched off
OS8,0;	OS<p>,0;	Control output number 8 is deactivated "minimum quantity lubrication"
OS10,0;	OS<p>,0;	Control output number 10 is deactivated "external 230 V socket (vacuum cleaner)"
(T0;)	*T<p>;*	*(Optional, current tool is deposited)*

6.7 Milling spindle and oscillating cutting

The CAM 2030 X is always operated with a milling spindle. As an additional option, however, the machine can also be operated with the cutting tools inserted, which can be automatically fetched and put down by the machine.

Minimum speed of the milling spindle	6,000 rpm	RVS6000;
Maximum speed of the milling spindle	40,000 rpm	RVS40000;

Minimum frequency oscillating cutting	32 Hz	RVS70;
Maximum frequency oscillating cutting	116 Hz	RVS255;

If the post processor outputs too high or too low a speed, the control automatically increases the speed to the minimum speed or reduces it to the maximum speed.

Exception: With the command RVS0; the spindle or the oscillating cutting knife is always stopped.

The lifting of cutting knives in the event of a change of direction or the oblique plunging in with V-Cut knives is carried out automatically by the control. The prerequisite for this is that cutting knives are treated like milling cutters in the NC code. A spindle speed must be stored for cutting knives, even if it is a stationary tool.

Sample output 1

Workpiece milling of a contour (blue cuboid) including minimum quantity lubrication and activated dust extraction, then tool change to a fixed knife with activated air cooling (black line).

Control commands	Abstract notation	Explanation
T10;	T<p>;	Tool 10 is fetched
GA0,0;	GA<p1,p2>;	The machine moves in rapid traverse to the set job zero point. Position: X = 0 mm and Y = 0 mm
OS10,1;	OS<p>,1;	Control output number 10 is activated "external 230 V socket (vacuum cleaner)"
OS8,1;	OS<p>,1;	Control output number 8 is activated "minimum quantity lubrication"
RVS10000;	RVS<p>;	The spindle speed is set to 10,000 rpm and the spindle is switched on
GA,,-5000;	GA,,<p>;	The machine moves in rapid traverse to the set safety distance position: X = 0 mm, Y = 0 mm, Z = -5 mm
VS5000;	VS<p>;	Feed = 5 mm/s
PA,,8000;	PA,,<p>;	Machine moves with a defined feed rate to: Z = 8 mm and remains in the X-axis and the Y-axis in the position where it was before.
VS30000;	VS<p>;	Feed = 30 mm/s
PA300000;	PA<p>;	Machine moves with a defined feed rate to: X = 300 mm and remains in the Y-axis and the Z-axis in the position where it was before.
PA300000,40000;	PA<p1>,<p2>;	Machine moves with a defined feed rate to: X = 300 mm and Y = 40 mm and remains in the Z-axis in the position it was in before.
PA0,40000;	PA<p1>,<p2>;	Machine moves with a defined feed rate to: X = 0 mm and Y = 40 mm and remains in the Z-axis in the position it was in before.
PA0,0;	PA<p1>,<p2>;	Machine moves with a defined feed rate to: X = 0 mm and Y = 0 mm and remains in the Z-axis in the position it was in before.
GA,,-5000;	GA,,<p>;	The machine moves in rapid traverse to the set safety distance position: X = 0 mm, Y = 0 mm, Z = -5 mm
RVS0;	RVS<p>;	The spindle speed is set to 0 rpm and the spindle is switched off

OS8,0;	OS<p>,0;	Control output number 8 is deactivated "minimum quantity lubrication"
OS10,0;	OS<p>,0;	Control output number 10 is deactivated "external 230V socket (vacuum cleaner)"
T48;	T<p>;	Tool 10 is put down and tool 48 is fetched
GA1000,20000;	GA<p1,p2>;	The machine moves in rapid traverse to the set position X = 1 mm and Y = 20 mm relative to the job starting point
GA,,-5000;	GA,,<p>;	The machine moves in rapid traverse to the set safety distance position: X = 0 mm, Y = 0 mm, Z = -5 mm
OS23,1;	OS<p>,1;	Control output number 23 is activated "air cooling"
RVS100;	RVS<p>;	Frequency is set to 45.5 Hz and oscillation is switched on
VS500000;	VS<p>;	Feed = 500 mm/s
PA,,200;	PA,,<p>;	Machine moves with a defined feed rate to: Z = 0.2 mm and remains in the X-axis and the Y-axis in the position where it was before.
PA290000;	PA<p>;	Machine moves with a defined feed rate to: X = 290 mm and remains in the Y-axis and the Z-axis in the position where it was before.
RVS0;	RVS<p>;	Frequency is set to 0 Hz and oscillation is switched off
OS23,0;	OS<p>,0;	Control output number 23 is deactivated "air cooling"

6.8 Registration marks

CNC Pilot requires the nominal position of the registration marks from the CAD program in relation to the job zero point. The actual position of the registration marks is measured on the machine itself with the built-in camera.

The information about the nominal position of the registration marks can be transmitted in two ways:

- via a second text file with the same name as the job file
- via metadata within the job

6.8.1 Registration marks with 2 files on the internal computer

The milling paths or cutting paths are mapped in a regular NC file. There is also a second file with the same name and the file extension “.cut”. The file with the file extension .cut must correspond to the MGE i-cut format.

Example:

File with NC code: Registration mark test.nc

File name for file with registration mark information: Registration-mark-test.cut

File content: The file needs a title (MGE i-cut script). The "SystemUnits" are either "mm" (millimeters) or "inch". This is followed by the information about the registration marks. One registration mark is defined for each line in the text file. The definition of a registration mark starts and ends with "RegMark", with the X and Y coordinates in between. A comma "," serves as a separator between the individual coordinates.

Example:

MGE i-cut script

SystemUnits mm

RegMark 0,0,RegMark

RegMark 0,150,RegMark

RegMark 100.5,100.5,RegMark

RegMark 120,0,RegMark

[...]

6.8.2 Registration mark information within the NC file

The information about the nominal position of the registration marks can also be written directly in the metadata of the NC code. The format should be mentioned at the beginning of the file. The registration mark positions are listed individually in micrometers. Optionally, each of the individual registration marks can be given a name.

Example:

```
//“NCFORMAT“: “vhf 1.0“\
//
“registrationMarks“: [
        {
                “position“: [<0>,<0>],
                “name“: “M1“
        },
        {
                “position“: [<0>,<150000>],
                “name“: “M2“
        },
        {
                “position“: [<100500>,<100500>],
                “name“: “M3“
        },
        {
                “position“: [<120000>,<0>],
                “name“: “M4“
        }
]
\
T10;
GA2000,0;
RVS6000;
GA,,-5000;
VS50000;
PA,,3000;
VS80000;
PA102000,50000;
PA2000,135000;
GA,,-2000;
RVS0;
//“NCEND“: “NCEND“\
```

7. Contact person

If you have any questions, please contact our support department by phone **+49 7032 97097 770** or by email **support@vhf.de**.