



INDUSTRIAL EQUIPMENTS PVT. LTD.

DynaCut ProX

CNC Shape Cutting Controller
with integrated plasma torch height control

OPERATION AND INSTALLATION MANUAL

Flame • Plasma • Marker • Tube and plate cutting

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Before You Begin

About this manual

This manual covers the Cruxweld **DynaCut ProX** two-axis CNC shape cutting controller and the **DynaCut ProX torch height controller** that works with it. Part A describes the cutting controller, Part B describes the torch height controller, and the appendices contain the quick code reference, the input / output timing charts, the installation sizes and a fault-finding list.

Read this manual, the manual of your cutting machine and the local safety regulations completely before the equipment is switched on. Keep the manual with the machine so that every operator can reach it.

Cruxweld improves its products continuously. The technical and hardware data given here may change without notice. If anything in this manual is unclear, or if you need information that is not covered, please contact Cruxweld; we shall be glad to answer your questions.

This product is not designed to be serviced in the field. Return it to the Cruxweld service centre for any repair work.

Operating conditions

- Working temperature 0 °C to 50 °C; relative humidity 5 % to 95 %, non-condensing.
- Supply DC +24 V, at least 80 W.
- Install the controller in a cabinet that keeps dust and cutting fume away from it.
- Keep the controller away from sources of strong high-voltage radiation.

WARNING - ELECTRIC SHOCK CAN KILL

- Install the equipment exactly as described in this manual and in accordance with the local electrical regulations.
- Never touch wiring or cabling while the power is on.
- Only trained persons may operate or install this controller.
- Do not open the controller unless you are authorised to do so.

WARNING - MOVING MACHINERY

- Keep hands clear of the machine. Every control action, manual movement included, can be started from the front panel or from the remote interface.
- Do not wear loose clothing or a tie while operating the machine; it can be caught by the machinery.
- Do not allow acid, alkali or any other corrosive substance to reach the controller.

Conventions used in this manual

- Keys of the operation panel are printed in square brackets, for example **[F1]**, **[ENTER]**, **[START]**.
- A key sequence is written with arrows, for example **[F5] → [F8] → [F3]**.
- In the code descriptions, "/" means *or* and square brackets enclose an optional item.

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PART A

CNC Shape Cutting Controller

Introduction • Operation • Parameters • Diagnostics • Codes • Ports and wiring

Chapter 1 Introduction

1.1 General description

The Cruxweld DynaCut ProX is a two-axis numerical control cutting controller for flame, plasma and laser cutting machines. It suits every two-axis machine that works in position-control mode: portal and gantry cutting machines, cantilever machines, portable and table machines, and tube / plate combination machines.

The controller is light and easy to handle, and every operation is guided by a menu or an illustration on the screen. All keys are laid out for comfortable use over a full working shift.

Inside, a high-performance ARM processor works together with a large-scale FPGA. The controller runs a multi-task real-time operating system and combines software interpolation with hardware interpolation, so that high-speed motion stays smooth and stable and the response to the operator is immediate. The protection mechanism has been developed through many years of experience with numerical control cutting systems.

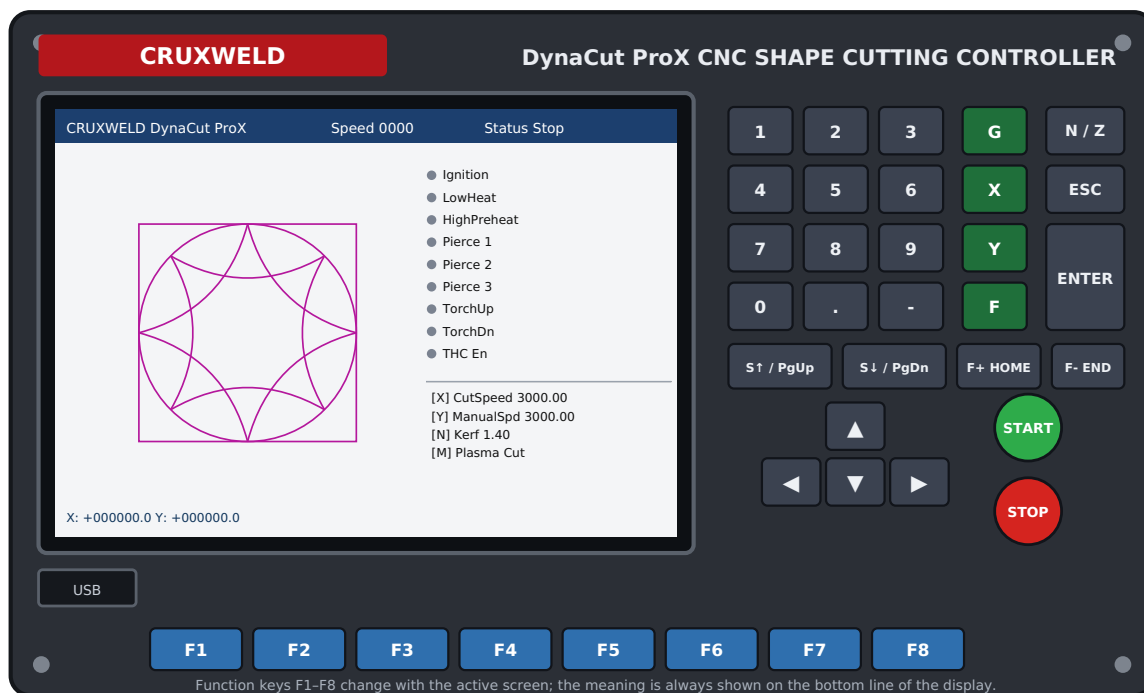


Figure 1.1 DynaCut ProX operation panel

1.2 Main features

1. Multilingual user interface. English is standard; other languages can be loaded from a language file supplied by Cruxweld.
2. Built-in library of 48 common shapes, most of them with both a plate size and a hole size.
3. Reads EIA (G code) files produced by the common nesting programs, with the file extensions TXT, CNC, NC, MPG and B3.
4. Compact keyboard; files are entered and edited directly on the controller.
5. Part operations: proportion (scale), rotation and mirroring.
6. Parts can be arrayed in a straight matrix, staggered or nested.
7. The part can be aligned to any edge of the steel plate.
8. The coordinate system can be customised; all eight two-dimensional orientations are supported.

9. The number and the type (normally open or normally closed) of every input and output port can be redefined by the user.
0. Self-diagnosis of the keyboard and of every I/O point makes inspection and commissioning simple.
1. USB socket on the front panel for copying cutting files.
2. The system software is upgraded from the USB stick, and Cruxweld provides the upgrade service for the life of the controller.
3. Files can be imported and exported singly or all together.
4. Time, weekday and clock display.
5. Parameter backup and parameter restore.
6. Four working modes: flame, plasma, marker and demonstration.
7. A full set of process parameters covers the different cutting techniques.
8. The flame and the plasma control outputs are separate.
9. Torch height control, two-level preheat and three-level pierce in flame mode.
0. Plasma arc feedback, positioning feedback and automatic arc shut-off at the corner.
1. Integrated plasma arc height control: the set arc voltage and the actual arc voltage are displayed, the height parameters are set from the panel, the collision and positioning signals are monitored and the arc-start signal is controlled.
2. Two ways of locking the height control – by speed and by distance – make the machine steadier and safer.
3. Edge cutting saves preheat time on thick plate.
4. The rate can be raised and lowered while the machine is running.
5. The cutting speed is limited automatically at a corner according to the plate thickness, which prevents over-burning.
6. A row or a pierce point can be selected manually.
7. Dynamic and static display of the process, zoom in and out, and dynamic tracking of the cutting point while zoomed.
8. A DSP core drives the machine accurately, quietly and stably at high speed.
9. Starting speed and acceleration are adjustable.
0. The working state and the last cutting point are memorised automatically when the power fails.
1. The cutting-offset function saves the plate when the nesting has been calculated wrongly.
2. Several levels of administration rights, each with its own password, protect the interests of the machine builder.
3. Supports point-to-point (P2P) and BCD (8421) remote controls as well as an RS232 serial remote control.
4. The original size of the workpiece and the size with kerf are displayed at the same time.
5. System backup and system restore; the restore can return the controller either to the backed-up operating system or to the factory condition.
6. Supports the commonly used ESSI code instructions.
7. Integrated torch height control module.
8. Laser pointer function.
9. Plasma dynamic pierce function.
0. Production statistics: number of workpieces, number of pierces, cutting length, cutting time and running time.

1.3 Technical data

Item	Data
Controlled axes	2 axes, linked (a third axis is available to order)
Control accuracy	± 0.001 mm
Coordinate range	$\pm 99\,999.99$ mm
Maximum pulse rate	200 kHz
Maximum speed	15 000 mm/min
Maximum lines of code	80 000 lines
Maximum size of one code file	4 MB
Time resolution	10 ms
Supply	DC +24 V, more than 80 W
Working temperature	-10 °C to +60 °C, humidity 0 % to 95 %
Torch height motor output	45 W standard, 200 W to order
Display	7 in, 800 × 480, high-brightness colour LCD (10.4 in and 15 in to order)
Memory	64 MB SDRAM
User program space	256 MB electronic disk
Processor clock	400 MHz
USB	USB 1.1 front socket; USB sticks up to 16 GB and above
Keyboard	Sealed PCB keyboard
Enclosure	All-steel, fully screened against electromagnetic radiation, interference and static

1.4 Connectors

Connector	Type	Function
CN1	DB25 male	16 opto-isolated inputs
CN2	DB25 female	16 opto-isolated outputs, maximum sink current 300 mA
CN3	DB15 male	Two-axis motor drive, differential outputs
CN4	7-pin terminal	Arc-voltage input, IHS proximity switch, arc-start output
CN5	5-pin terminal	Torch height motor output and limit inputs
CN6	DB9 male	RS232 serial port for the serial remote control (to order)
USB	USB 1.1, front panel	Transfer of cutting code, parameters and system upgrades
POWER IN	3-pin terminal	24 V-, 24 V+, PE

The arc input of the height control module can be set to a division ratio of 50 : 1 or 100 : 1 by a switch inside the controller. The factory setting is 100 : 1.

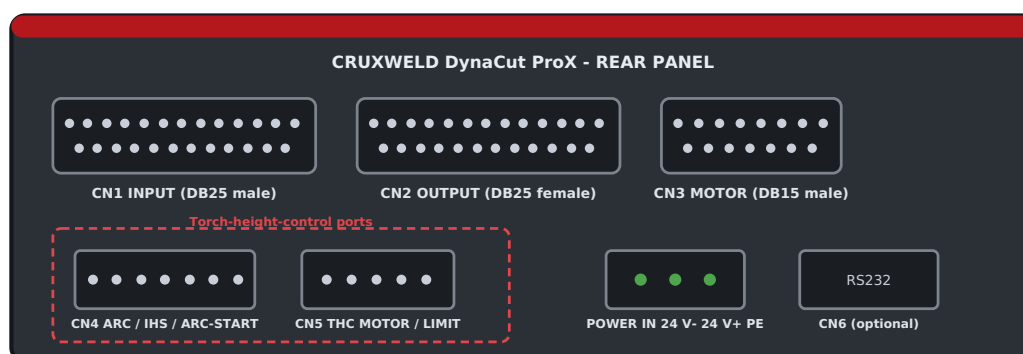


Figure 1.2 Rear panel of the DynaCut ProX

Chapter 2 Starting Up

2.1 The keys of the operation panel

Key	Function
[F1] – [F8]	Function keys. Their meaning changes with the screen and is always shown on the bottom line of the display.
[S↑ / PgUp]	Page up in the editor; torch up in every other screen.
[S↓ / PgDn]	Page down in the editor; torch down in every other screen.
[F+ / HOME]	Increase the rate; in the editor, jump to the beginning of the code line.
[F– / END]	Reduce the rate; in the editor, jump to the end of the code line.
[1] – [9]	While cutting, set the rate to that fraction of the speed limit. [3] gives 30 %, [8] gives 80 %, and so on.
[2] / [3]	Adjust the pierce time quickly.
[5] / [6]	Adjust the initial-height-sensing time quickly.
[8] / [9]	Set the arc voltage quickly.
[0]	Disable or enable the torch height control.
[.]	Initial-height-sensing (IHS) test.
[START] / [F9]	Start cutting.
[STOP] / [F10]	Pause; every action in progress is suspended.
[SPACE]	Enter the cutting screen from the main screen.
[ESC]	Leave the present screen or cancel the present entry.

When the torch height control is fitted, the quick-speed keys are [1], [4] and [7]; the remaining number keys are used for the height-control short cuts listed above.

2.2 Switching on

When the supply is switched on the controller first shows the BIOS start-up screen.



Figure 2.1 BIOS start-up and self-check screen

A three-second countdown then runs. Press **[F2]** during the countdown to enter the BIOS (see Chapter 12). Press any other key to skip the countdown and go straight to the welcome screen. If no key is pressed the countdown reaches zero and the welcome screen appears by itself. Press any key in the welcome screen to reach the main screen.



Figure 2.2 Welcome screen

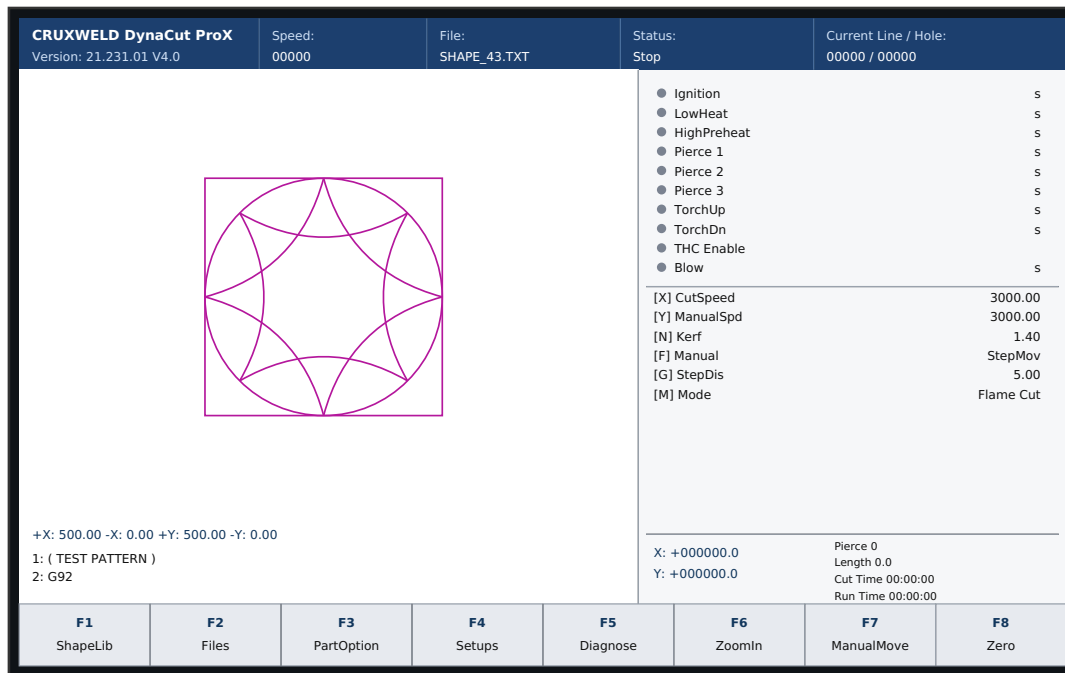


Figure 2.3 Main screen

2.3 The main screen

The left-hand pane shows the path of the present workpiece and, below it, the line of G code being processed together with the next line. The right-hand pane shows the state of the process outputs, the present settings and the production counters. The top line shows the speed, the file name, the machine state and the line or hole being cut.

Key	Function in the main screen
[F1] ShapeLib	Open the shape library: 48 common shapes, most of them with a plate size and a hole size.
[F2] Files	Load a file from the internal disk or from the USB stick; edit, import, export or delete code.
[F3] PartOption	Mirror, rotate, align to the plate, array, select a row or a pierce point, edit the code.
[F4] Setups	Set all parameters.
[F5] Diagnose	Input and output diagnosis, keyboard diagnosis, self-check, date and time, port definition.
[F6] ZoomIn	Enlarge the shape to the full screen.
[F7] ManualMove	Move the machine by hand.
[F8] Zero	Clear the X and Y coordinates before a cut or after a cut is finished.
[X] CutSpeed	Set the cutting speed.
[Y] ManualSpeed	Set the manual movement speed.
[F] Manual	Choose the manual movement mode: KeepMov, StepMov or ContiMov.
[G] StepDis	Set the distance of one step in StepMov.
[N] / [Z]	Set the kerf compensation before the cut is started.
[M]	Choose the cutting mode: Flame Cut, Plasma Cut or Demo Run.

2.4 Function index

Main screen	Level 1
F1 ShapeLib	F1 Film size • F2 Hole size
F2 Files	F1 Disk file • F2 U-disk file • F3 Search • F4 Edit • F5 Delete • F6 Copy to USB • F7 Preview • F8 OK
F3 PartOption	F1 Start point • F2 Angle • F3 Array • F4 Scale • F5 Select line / pierce • F6 Edit file • F7 Revert • F8 OK
F4 Setups	F1 Common • F2 Flame • F3 Plasma • F4 Marker • F5 System • F6 Import • F7 Export • F8 Save
F5 Diagnose	F1 Input • F2 Output • F5 Keyboard • F6 Self-check • F7 Date and time • F8 System definition
F5 → F8 System definition	F1 Parameter recovery • F2 Parameter backup • F3 Definition (F1 Input, F2 Output, F3 Axes, F4 Motor, F5 Option, F6 Option 2, F8 Save) • F4 Encryption • F5 Decryption • F6 Language • F7 Clear files • F8 Update
F7 ManualMove	F1 Keep moving • F2 Continuous moving • F3 Step moving • F4 Speed down • F5 Speed up • F7 Breakpoint recovery • F8 Go back

Chapter 3 Cutting Functions

Press **[SPACE]** in the main screen to enter the cutting screen.

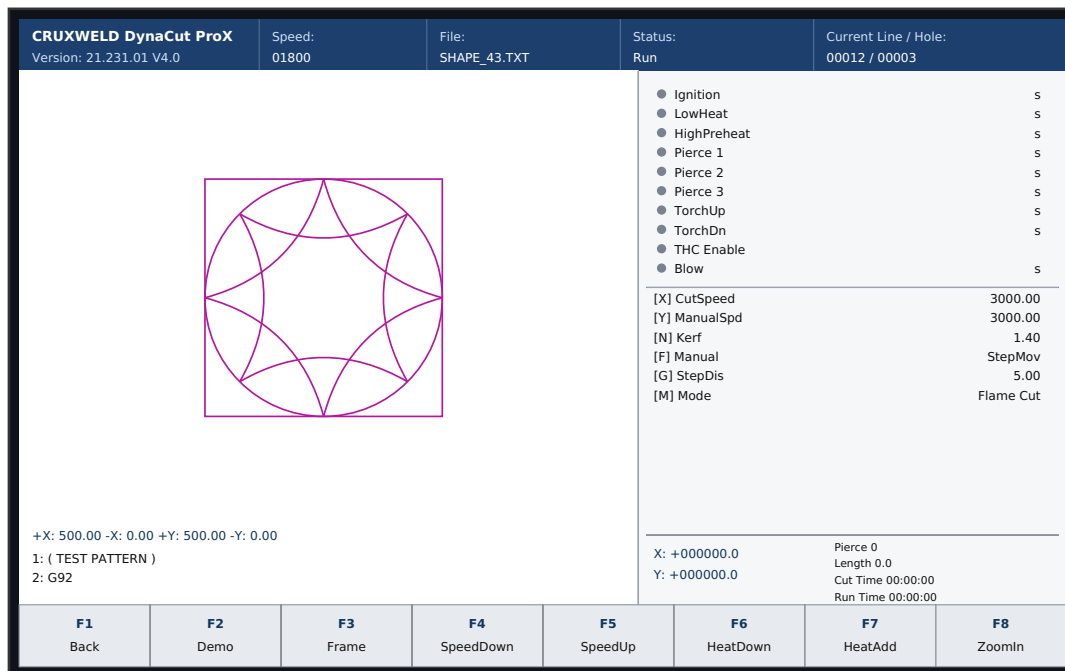


Figure 3.1 Cutting screen, flame mode

3.1 The cutting screen

- The large pane shows the cutting path of the present workpiece.
- Below it the G code file is listed, with the present line and the next line.
- The top line shows the present cutting speed. While cutting or while paused, press **[1]** – **[9]** for a quick rate change: **[3]** sets 30 %, **[8]** sets 80 %. With the torch height control fitted, only **[1]**, **[4]** and **[7]** act as rate keys.
- X and Y show the absolute position of the torch.

Key	Function in the cutting screen
[START]	Start cutting.
[STOP]	Pause every action in progress.
[F1] Back	Move backwards along the cutting path with all outputs closed.
[F2] Demo	Move forwards along the path with all outputs closed.
[F3] GoBack / Frame	Return to the start point of the present workpiece, or run round the frame.
[F4] SpeedDown	Reduce the rate by 3 % per press.
[F5] SpeedUp	Raise the rate by 3 % per press.
[F6] HeatDown	End the preheat early; the controller memorises the shorter preheat time.
[F7] HeatAdd	Add 15 s to the preheat time.
[F8] Jump / ZoomIn	While paused, select a new pierce point; while running, enlarge the path to the full screen.
Arrow keys	Move the machine by hand.
[X] [Y] [F] [G]	Change the cutting speed, the manual speed, the manual mode and the step distance.

3.2 Rate control

Normal rate control. Press **[F5]**, **[PRE]** or **[HOME]** to raise the rate by 3 % per press; hold the key and the rate rises continuously to the maximum cutting rate. Press **[F4]**, **[NEXT]** or **[END]** to lower the rate by 3 % per press; hold the key and the rate falls continuously to 0.5 % of the maximum cutting rate.

Quick rate control. While the machine is running automatically, or while it is paused, press a number key in the cutting screen and the rate jumps to ten times that figure as a percentage of the speed limit.

3.3 Forward and backward along the path

Forward. Press **[F2]** in the automatic screen and the machine follows the shape without cutting: no ignition, no pierce and no other output is executed. Press **[F2]** again to stop. Use this to check the path or the code before cutting, or when the pierce point has to be shifted. The forward speed is set separately by the *Demo / back speed* common parameter.

Backward. If the plate has not been cut through and you want to go back along the shape:

1. Press **[STOP]** to pause the machine.
2. Press **[F1]** (Back). The machine runs backwards along the shape. Press **[STOP]** when the torch has reached the position you want. If it has gone too far, press **[F2]** to go forward again. Forward and backward may be repeated as often as necessary.
3. Press **[START]**. If the present line is G01, G02 or G03 the controller pierces automatically before it continues; otherwise it simply carries on with the present line.

3.4 Edge cutting, offset cutting and return

If the torch is not on the path of the present workpiece the controller offers three choices.

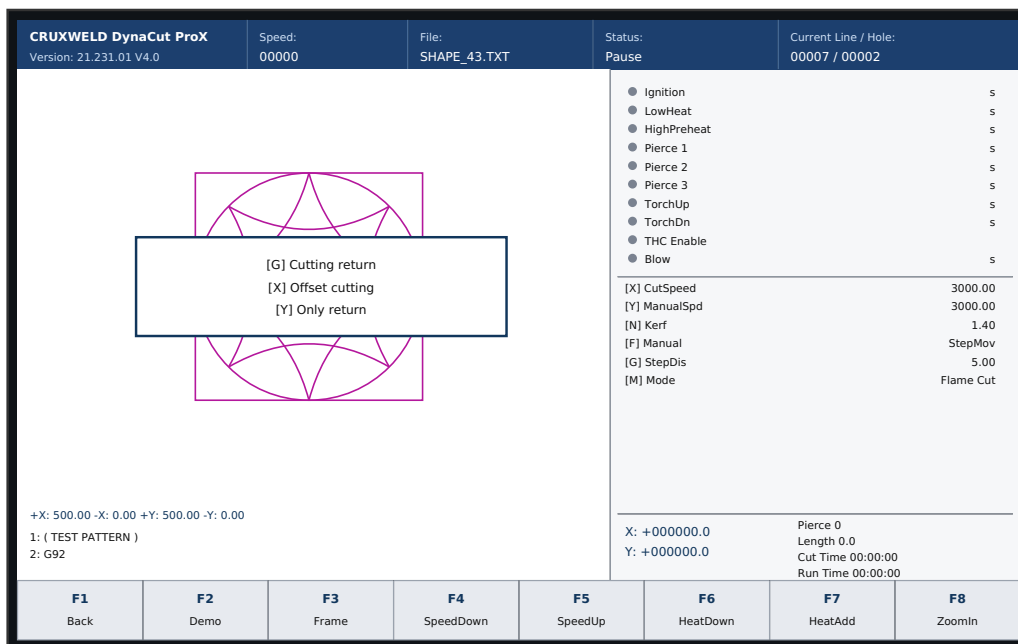


Figure 3.2 Edge cutting prompt

This prompt appears in two situations: when the common parameter *Edge cutting enable* is ticked and the next line to be processed is M07, so that the controller stops by itself and lets you move the torch to the edge of the plate; or when the machine has been paused and the torch has been moved off the real path.

- **[G] Cutting return** – the controller cuts from the present point back to the point at which it was paused and then carries on. On thick plate this saves a great deal of preheat time.
- **[X] Offset cutting** – the controller offsets the present point onto the paused point and carries on cutting. Use this when the torch is no longer on the correct path after a pause or a power failure.
- **[Y] Only return** – the controller moves quickly to the paused point and then pauses. Use this after the torch has been taken out of the cutting area for maintenance; press **[START]** to continue.

3.5 Return to the reference point

Pause the machine and press **[F3]**. The controller asks *Are you sure to return?*. Press **[ENTER]** and it runs back to the start point of the workpiece and returns to the main screen. Press **[STOP]** during the return to interrupt it and **[F3]** to resume; there is no limit on the number of interruptions.

3.6 Preheat time control

- During preheat, press **[START]** to skip the rest of the preheat or pierce delay.
- Press **[STOP]** to hold the preheat until **[START]** is pressed again.
- Press **[F6]** to end the preheat now. The controller memorises the time actually used and applies it to the following pierces until M02 or M30. For example, if the preheat is set to 60 s and **[F6]** is pressed with 10 s still to run, 50 s is stored as the new preheat time.
- Press **[F7]** to add 15 s to the preheat. The longer time is kept for the rest of the cut.

3.7 Jump to a pierce point

Before cutting starts, or while it is paused, **[F8]** is labelled *Jump to pierce*. Press it and the controller asks *Jump to new pierce?*. Press **[ESC]** to return to the cutting screen or **[ENTER]** to go on; then key in the number of the pierce point, or press **[ESC]** and use **[+]** and **[-]** to step through the pierce points.

3.8 Dynamic magnification

Once cutting has started, **[F8]** is labelled *ZoomIn*. Press it to enlarge the path over the full screen with dynamic tracking of the cutting point. Press it again for a further step of magnification and **[ESC]** to return to the cutting screen.

3.9 Leaving a cut

If the cut is not finished and the machine is paused, press **[ESC]**. The controller asks whether the cut is to be abandoned. **[ENTER]** cancels the job; **[ESC]** keeps it, and cutting resumes from the point at which it was paused.

3.10 Running round the frame

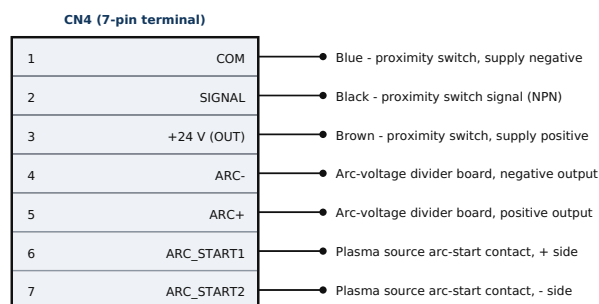
Before the job is started, **[F3]** in the automatic screen is labelled *Frame*. The machine then runs round the rectangle that encloses the part, counter-clockwise, beginning at the lower left corner, so that you can check that the part fits on the plate. At the end the controller asks *Quit frame test?*. **[ENTER]** returns the machine to the start point of the part; **[ESC]** leaves it where it is. Press **[STOP]** during the frame run to suspend it and **[START]** to resume; press **[F3]** again to return to the start point.

3.11 Torch height control

3.11.1 Wiring

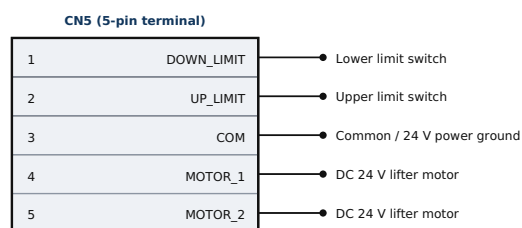
The controller is connected to the positioning proximity switch, to the arc-start contact of the plasma source and to the arc-voltage divider through the seven-pin socket CN4, and to the lifter motor through the five-pin socket CN5.

Figure 3.11 Arc-voltage, IHS and arc-start wiring (CN4, 7-pin)



PE: bond the screen of the arc-voltage cable to the earth stud of the controller.

Figure 3.12 Lifter motor and limit-switch wiring (CN5, 5-pin)



Maximum motor power 45 W. If no limit switches are fitted, link DOWN_LIMIT and UP_LIMIT to COM.

Section 11.4 gives the complete wiring of the arc torch-height module, including the divider board and the isolating relay.

3.11.2 Set arc voltage and actual arc voltage

In the main screen and in the automatic screen, the set arc voltage and the actual arc voltage are displayed above the process indicators.

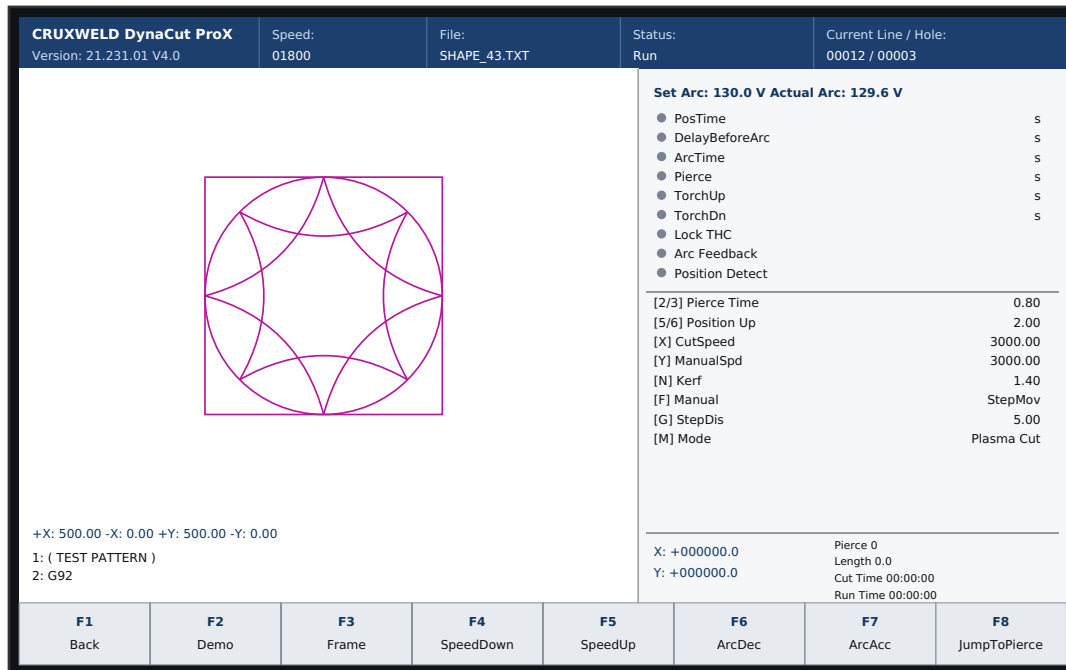


Figure 3.3 Automatic screen with arc torch-height control

3.11.3 Initial height sensing (IHS)

Several settings have to be made before initial height sensing can be used.

- Connect the proximity switch to CN4 (the SIGNAL pin).
- In the diagnosis screen, *Position detect* must read NO while the torch is clear of the plate and NC when the torch touches the plate.
- The plasma parameter *Position check time* must be longer than the time the torch needs to travel from its highest point down to the plate.
- The plasma parameter *Position up time* is the time the torch takes to rise from the plate to the arc-ignition height.

With the machine stopped or paused, press [.] to run an IHS test. The torch descends for at most the Position check time; as soon as the tip reaches the plate and the proximity switch operates, the torch stops and rises for the Position up time. If the torch does not reach the plate within the Position check time a warning window appears.

3.11.4 Setting and trimming the arc voltage

- The arc voltage is set in the plasma parameter screen; see section 7.3.
- In the automatic screen in plasma mode, [F6] lowers and [F7] raises the set arc voltage.
- In the automatic screen and in the main screen in plasma mode, [8] lowers and [9] raises the set arc voltage.
- The step is the *Arc set step value* plasma parameter.

3.11.5 Enabling and disabling the height control

- In plasma mode, [0] switches the height control off and on.
- [PgUp] raises and [PgDn] lowers the torch at full speed. While the height control is working these keys still move the torch; the height control takes over again as soon as the key is released.

3.11.6 Collision and IHS signal check

- Outside plasma mode, if the torch touches the plate and the *Plasma collision* (CN1 pin 6) or *Position detect* (CN1 pin 5) input becomes active, the torch rises automatically for the Position up time.
- In plasma mode, the same signals stop the machine and raise the torch for the Torch up time.

3.12 Production statistics

The controller records the number of pierces, the number of finished workpieces, the total cutting length, the cutting time and the running time. Flame cutting and plasma cutting are counted separately.

Counter	Meaning
Pierce count	Number of pierces made during cutting.
Workpiece count	Number of workpieces completed.
Cut length	Total cutting length. Metric: metres. Imperial: feet.
Cut time	Total time spent cutting.
Run time	Cutting time plus rapid-traverse time plus the time spent in the M07 state.

In flame mode the counters are shown in the lower right corner of the cutting screen. In plasma mode the same corner shows the plasma counters. In demonstration mode no counters are displayed. Each counter can be cleared separately in the flame or plasma parameter screen.

3.13 A typical cutting cycle

1. Load the part: press **[F1]** for a library shape or **[F2]** to load a G code file.
2. Set the kerf with **[N]** and choose the cutting mode with **[M]**.
3. Check and if necessary adjust the process parameters with **[F4]** (Setups).
4. Align the part to the plate if required: **[F3]** (PartOption) → **[F2]** (Angle).
5. Move the torch to the start point with **[F7]** (ManualMove) and press **[F8]** (Zero) to clear the coordinates.
6. Press **[SPACE]** to enter the cutting screen and **[F3]** to run round the frame as a final check.
7. Press **[START]**.

CAUTION

Never leave the machine unattended while it is cutting. Keep the emergency-stop button within reach, and make sure that the exhaust and fume extraction are working before the arc is struck.

Chapter 4 Part Options

Press **[F3]** (PartOption) in the main screen before cutting is started.

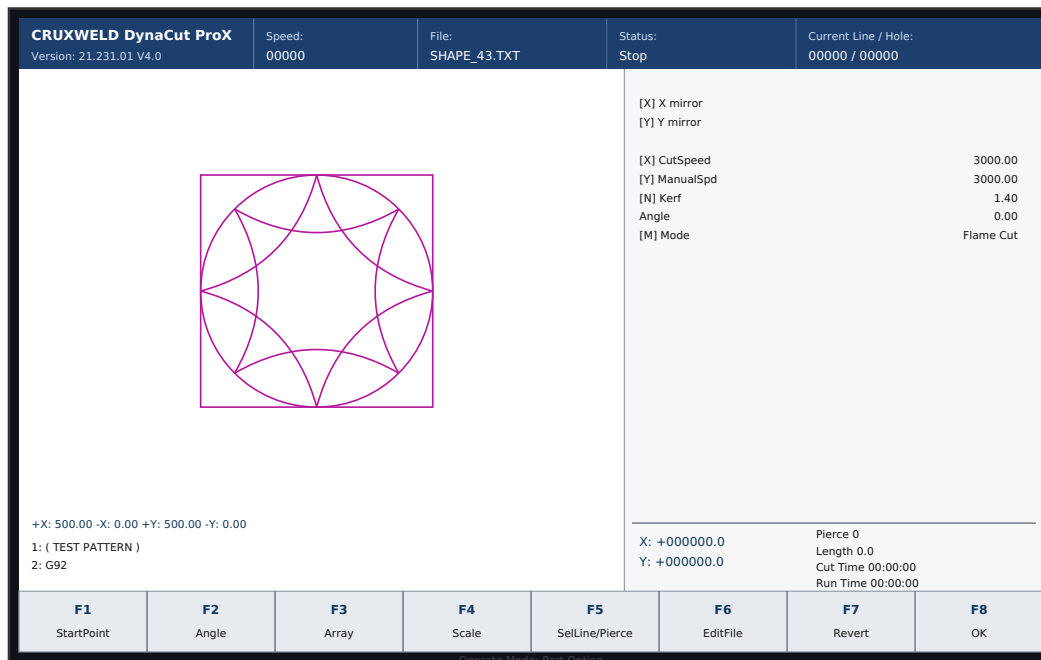


Figure 4.1 Part option screen

4.1 Mirroring

Press **[X]** to mirror the part about the horizontal (X) axis and **[Y]** to mirror it about the vertical (Y) axis.

4.2 Start point

Press **[F1]** and the controller offers five positions for the start point of the part:

Key	Start point
[F1]	Centre of the part
[F2]	Left and bottom corner
[F3]	Left and top corner
[F4]	Right and bottom corner
[F5]	Right and top corner

The start point of the part jumps to the chosen corner at once. Pressing **[F4]**, for example, moves it to the lower right corner.

4.3 Aligning the part to the plate

Press **[F2]**. The controller offers:

- **[F1]** – align the part to the steel plate;
- **[F2]** – key in the alignment angle directly;
- **[ESC]** – leave the angle adjustment.

4.3.1 Aligning to the plate

The controller prompts *X-start Y-OK ESC-exit*. Move the torch by hand to any edge or corner of the plate and press **[X]** to fix that point as the start of the correction. Move the torch far enough along the same edge to a second point and press **[Y]**. The controller works out the angle of the plate and turns the part image to match.

If a laser cross is fitted, the cross can be used to align to the plate edge; see section 5.5.

When the alignment is finished the controller asks whether to return to the start point. **[ENTER]** runs the machine back to the start point of the job; **[ESC]** leaves the machine where it is and returns to the automatic screen.

4.3.2 Keying in the angle

When the angle of the plate is already known it can be typed in:

```
Please enter angle  min: -360  max: 360
Angle: 0.00
> 0  rotate counter-clockwise from the present position
< 0  rotate clockwise from the present position
= 0  reset the part to 0 degrees
```

Press **[ENTER]** to confirm; the part image turns by the angle entered. Entering 0 restores the part to 0° and clears both the plate-alignment angle and the manually entered angle. Normally the angle entered here is *not* treated as the plate-alignment angle; to make it so, see section 8.7.6.8.

Whether the plate angle is remembered after the machine is switched off is set by the *Steel angle remember* option; see section 8.7.6.6.

4.4 Array

Press **[F3]** in the part option screen. Three array types are available:

- **[F1] Straight** – a plain matrix of rows and columns;
- **[F2] Stagger** – alternate rows offset by half a pitch;
- **[F3] Nest** – two parts interlocked and then arrayed.

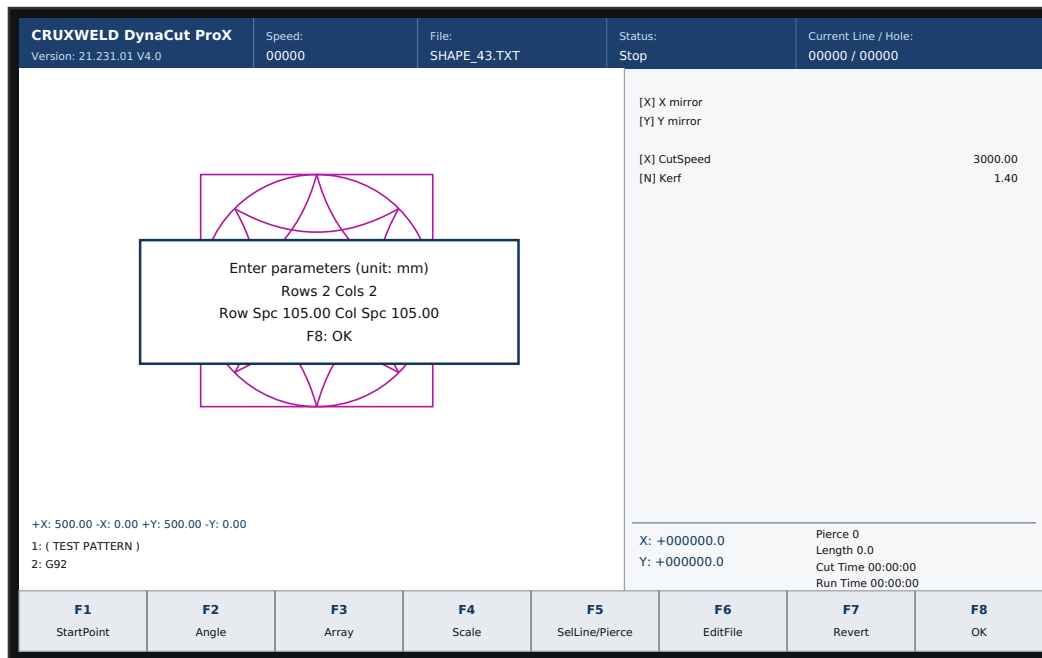


Figure 4.2 Entering the array parameters

For a straight or a staggered array, enter the number of rows and columns and the row and column pitch in millimetres, then press **[F8]**.

The nested array suits shapes that interlock, such as triangles and trapeziums. The controller first turns a copy of the part through 180° about its centre, interlocks the original and the copy into a new pattern, and then arrays that pattern in the staggered manner. Its parameters are:

Parameter	Meaning
Y nest distance	Distance in Y between the centres of the two interlocked parts. May be negative.
X nest distance	Distance in X between the centres of the two interlocked parts. May be negative.
Number of rows	Number of rows in which the combined pattern is arrayed.
Number of columns	Number of columns in which the combined pattern is arrayed.
Y pattern offset	Y pitch of the combined pattern.
X pattern offset	X pitch of the combined pattern.

4.5 Proportion (scale)

Press **[F4]** in the part option screen, key in the scale factor and press **[ENTER]**. If the value is legal the shape is scaled at once.

The scale factor is applied to the lead-in and the lead-out as well as to the shape itself.

4.6 Selecting a line or a pierce point

Press **[F5]** in the part option screen, then:

- **[F1] Select line** – key in the number of the G code line at which cutting is to begin, or press **[ENTER]** and step through the lines with **[←]** and **[→]**. Press **[F8]** to confirm.
- **[F2] Select pierce** – the same procedure, but the pierce points are stepped through instead of the code lines.

After the line or the pierce point has been chosen, press **[F8]** to return to the main screen and **[SPACE]** to enter the automatic screen. Two ways of working are then possible.

1. **Move to the chosen position and then cut.** Press **[F1]** in the automatic screen; the machine runs to the chosen line or pierce point without cutting and pauses. Alternatively press **[START]** and answer the prompt with **[Y]** (only return).
2. **Cut from the present position.** Press **[START]** and answer the prompt with **[X]** (offset cutting).

4.7 Restore

Press **[F7]** in the part option screen to cancel every part operation – mirroring, angle adjustment, scaling and array – and return the part to its original state.

Chapter 5 Manual Functions

Press **[F7]** (ManualMove) in the automatic screen to reach the manual screen.

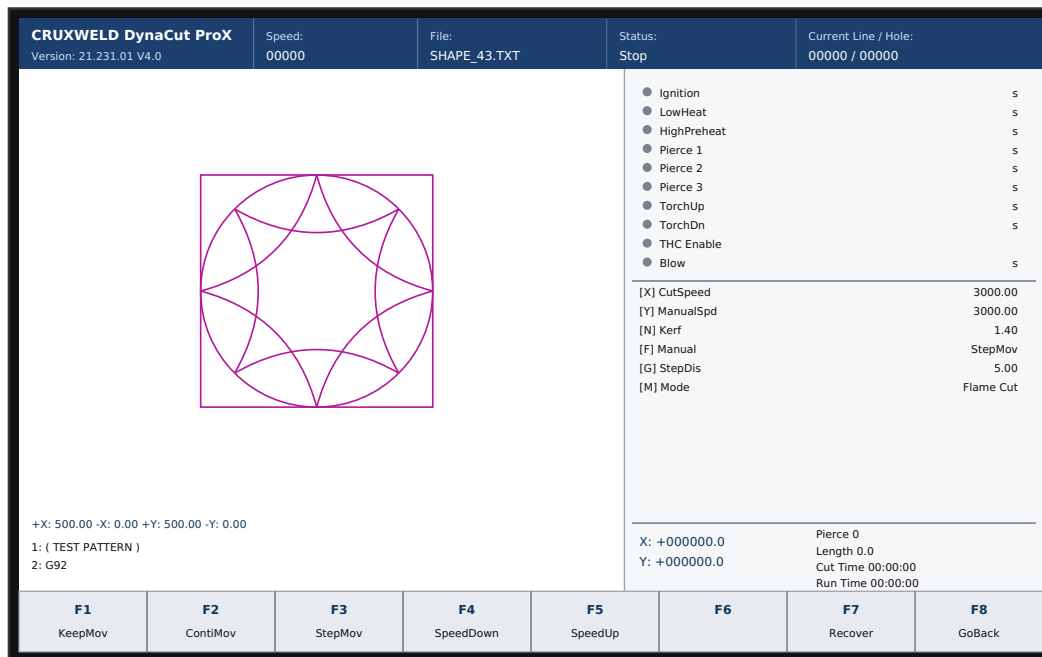


Figure 5.1 Manual screen

The manual speed is raised with **[HOME]** and lowered with **[END]**. A number key sets the manual speed to ten times that figure as a percentage of the speed limit: **[3]** gives 30 %, **[8]** gives 80 %.

5.1 Keep moving

Press **[F1]**. The machine moves in the chosen direction for as long as the direction key is held down and stops as soon as the key is released.

5.2 Continuous moving

Press **[F2]**. This is the default setting when the manual screen is opened. The machine starts to move when a direction key is pressed and released, and keeps moving until any direction key or the stop key is pressed.

5.3 Step moving

Press **[F3]** and key in the step distance. Each press and release of a direction key then moves the machine one step in that direction. Pressing any direction key or the stop key while the step is running stops the movement.

5.4 Breakpoint recovery

The controller stores a breakpoint in two cases:

1. whenever the machine is paused, the paused point is stored as the breakpoint;
2. if the supply fails while cutting, the position at that moment is stored as the breakpoint.

To recover from the breakpoint, switch the controller on again and **do not move the torch**. Press **[F7]** in the main screen to reach the manual screen and **[F7]** again to recover the breakpoint. If the torch is still standing exactly where it was when the power failed, press **[START]** and the job continues from the breakpoint.

If the torch is no longer in exactly the right place, move it there by hand and check the position with the forward, backward and offset-cutting functions.

Alternatively, move the torch to the start point of the part, select the line or pierce point (see section 4.6), press **[START]** and choose *only return*. The controller then offers:

- **[G]** – cut from the present point to the start point of the selected line or pierce point;
- **[X]** – offset the present point onto the start point of the selected line or pierce point;
- **[Y]** – move without cutting from the present point to the start point of the selected line or pierce point.

5.5 Laser offset

A laser cross may be mounted beside the cutting torch at a fixed distance from it. Once that distance has been entered in the marker parameters (section 7.4), two extra keys appear in the manual screen:

- **[F4] Laser offset** – moves the machine so that the laser cross stands where the torch tip stood.
- **[F5] Laser back** – moves the machine so that the torch tip stands where the laser cross stood.

The laser cross is much easier to aim than the torch tip, so this pair of keys is useful for aligning to the plate and for finding the start point on the plate. When the laser offset function is fitted, **[F4]** and **[F5]** take the place of the speed keys in the manual screen.

Chapter 6 File Operations

The controller reads cutting files with the extensions TXT, CNC, NC, B3 and MPG. The largest file is 4 MB and the longest file has 150 000 lines. Files can be edited, compiled, deleted, exported and imported.

Limit	Value
Total number of files in the controller	less than 5 000
Number of files in one folder	less than 1 000
Length of the file path on the USB stick	133 bytes
Length of a folder name on the internal disk	13 bytes
Length of a file name	less than 64 bytes
Characters per line in the editor	128

Press **[F2]** in the main screen to open the file manager. The function keys are then:

Key	Function
[F1] DiskFile	List the supported files on the internal disk.
[F2] U Disk	List the files on the USB stick.
[F3] Search	Search for a file by all or part of its name.
[F4] EditFile	Edit the file at the cursor.
[F5] DelFile	Delete the file, the folder or every file.
[F6] CopyToU	Copy the file to the USB stick (or, in the USB screen, to the internal disk).
[F7] Preview	Show the shape of a G code file.
[F8] OK	Load the file into the controller.

6.1 Files on the internal disk

Press **[F1]**. All supported files are listed. Move the cursor with the arrow keys and use the function keys listed above.

6.2 Files on the USB stick

Press **[F2]**, select the file and press **[F6]** to copy it to the internal disk. Key in the file name, or press **[ENTER]** to keep the existing name. If a file of that name already exists the controller asks *File exists, confirm to cover?*; **[ENTER]** overwrites it and **[ESC]** cancels.

A file on the USB stick can also be loaded straight into the controller without being copied first. It is then stored automatically under the name `ufile.txt`.

6.3 Searching for a file

Press **[F3]**, key in all or part of the file name and press **[ENTER]**. Every file whose name contains the string is listed.

6.4 Editing a file

Move the cursor to the file and press **[F4]**. Keys carrying two characters give the lower character when pressed alone; press **[Shift]** first, or hold it down, for the upper character.

Key	Function in the editor
[F1] Compile	Check the file for errors.
[F2] AddRow	Insert a new line after the present line.
[F3] DelRow	Delete the present line.
[F4] NewFile	Create a new file.
[F5] NewFolder	Create a new folder.
[F+ / Home]	Jump to the first character of the line.
[F- / End]	Jump to the last character of the line.
[F8] Save	Save the file.

A file opened from the USB stick, and a newly created file, must be saved before it is used; otherwise breakpoint recovery cannot work.

6.5 Deleting files

Press **[F5]** in the file manager:

- **[F1] Delete file** – delete the file at the cursor;
- **[F2] Delete folder** – delete every G code file in the present folder;
- **[F3] Delete all files** – delete every G code file in the controller.

6.6 Creating a file

In the editor, press **[F4]** to create a new file.

6.7 Compiling the code

After a file has been written or edited, press **[F1]** in the editor to compile it and check that the code is legal.

6.8 Folders

The controller holds ten folders. The bottom of the file-manager screen shows them as:

```
Work folder: /flash
0 - /flash  1 - DIR1  2 - DIR2  3 - DIR3  4 - DIR4
5 - DIR5    6 - DIR6  7 - DIR7  8 - DIR8  9 - DIR9
```

The figure in front of each name is the short-cut key. Press **[1]** and the work folder changes to `/flash/DIR1`.

To create a folder, open the editor (section 6.4), press **[F5]**, key in the folder name and press **[ENTER]**.

Only ten folders are supported. When ten already exist, a new folder replaces the second one, then the third, and so on. The first folder, `/flash`, is reserved and can be neither replaced nor renamed.

6.9 Transferring files - practical notes

- Format the USB stick as FAT or FAT32.
- Put the cutting files in the root directory of the stick, or in a folder with a short name; the whole path may not exceed 133 bytes.
- Use only the supported extensions. A file with any other extension is not listed.
- If the controller reports *Tip no file*, check that the stick really holds a supported file, that the file is in the root directory, and that the stick is formatted correctly.
- If a file cannot be opened, compile it with **[F1]** in the editor: the compiler reports the first illegal line.

Chapter 7 Parameter Setting

Press **[F4]** (Setups) in the main screen. Five groups of parameters are available:

Key	Group
[F1] Common	Cutting speed, manual speed, G00 speed, kerf, corner speed, cutting type.
[F2] Flame	Every parameter used in oxy-fuel cutting, including edge-cutting enable.
[F3] Plasma	Every parameter used in plasma cutting.
[F4] Marker	Ignition and pierce cycle of the marker, and the marker gun offset.
[F5] System	Pulses per millimetre, speed limits, acceleration and soft limits.
[F6] Import	Import a parameter file from the USB stick or from the internal disk.
[F7] Export	Export the parameters to the USB stick or to the internal disk.
[F8] Save	Save the parameters.

IMPORTANT

Any parameter that has been changed must be saved with **[F8]** before the screen is left, otherwise the controller continues to work with the old value.

7.1 Common parameters

Parameter	Unit	Meaning
Max cutting speed	mm/min	The present cutting speed.
Manual move speed	mm/min	Speed of manual movement.
G00 move speed	mm/min	Rapid-traverse speed used by G00.
Demo / back speed	mm/min	Speed used when running forwards or backwards along the path without cutting.
Marker speed	mm/min	Speed used while powder marking.
Kerf value	mm	Kerf compensation applied to the present part program. Set half of the real kerf width.
Corner speed (1-100)	%	Speed limit at a corner. Between 10° and 35° the controller limits the speed automatically; below 10° the speed is not limited; above 35° the speed falls to the starting speed.
Demo run speed	mm/min	Speed used in demonstration mode.
Cutting type	-	Flame, Plasma or Demonstration.

7.2 Flame parameters

Parameter	Default	Meaning
Ignition time	1.0 s	Delay after the ignition output is switched on.
Low preheat time	30.0 s	Preheat time before the plate is pierced. Press [STOP] to hold the preheat until [START] is pressed, or [F7] to add 15 s; the longer time is remembered.
High preheat time	0.00 s	As the low preheat, but on a separate output and executed before it.
Pierce 1 time	0.00 s	Pierce with low-pressure oxygen.
Pierce 2 time	0.00 s	Pierce with medium-pressure oxygen.
Pierce 3 time	0.00 s	Pierce with high-pressure oxygen.
Blow time	0.00 s	Time for which the blow output stays on after the cutting oxygen is shut off.

Parameter	Default	Meaning
Torch up time	0.00 s	Time used to lift the torch after each cut, so that it clears the cut parts and returns to its rest position.
Torch down time	0.00 s	Time used to lower the torch at the beginning of each new cut. Normally longer than the pierce torch-down time because the torch starts from its rest position.
Pierce up time	1.0 s	Time used to lift the torch during piercing, which sets the distance between the tip and the plate.
Pierce down time	30.0 s	Time used to lower the torch during piercing.
THC enable	-	Switches the torch-height-control output on or off in flame cutting.
Hold preheat	-	When ticked, the low-preheat output stays on between cuts and is shut off only when the whole file is finished. It can also be kept on after the file is finished; see section 8.7.6.11.
Edge cutting enable	-	When ticked, the controller stops at every pierce point so that the torch can be moved to the edge of the plate. See section 3.4.
Crawling speed	600 mm/min	Creep speed used when the crawl function is on. See section 8.7.6.9.
Crawling time	0.40 s	Time for which the machine travels at creep speed after the pierce. When it has elapsed the controller accelerates to full cutting speed. Creep lets the cut face come up to temperature and the plate pierce right through before full speed is reached.
Pierce count	0	Number of pierces made in flame cutting. Can be cleared.
Workpiece count	0	Number of workpieces finished in flame cutting. Can be cleared.
Cut length (m)	0	Total flame cutting distance. Metric: metres. Imperial: feet.
Cut time	00:00:00	Time spent flame cutting.
Run time	00:00:00	Flame cutting time plus rapid traverse plus pierce time.

Edge cutting. Thick plate is hard to pierce and the pierce hole is large. If the hole is punched on the cutting path it can spoil the finished part. Piercing at the edge of the plate and cutting in from there raises the piercing rate, saves time and improves the quality. A lead-in is an equally effective alternative.

7.3 Plasma parameters

Parameter	Default	Meaning
Delay before arc	0.00 s	Waiting time before piercing begins. Every output is off during this time.
Pierce time	0.00 s	Delay between the end of the torch descent and the start of motion at creep speed, so that the torch pierces the material completely before the machine moves.
Torch up time	2.00 s	Time for which the torch is raised at the beginning and at the end of each cut, to clear the cut parts. Set it to zero when an automatic height control is used.
Arcing check time	15.00 s	Time allowed between the arc-on command and the arc-on feedback. If the feedback arrives within this time the machine moves off and cuts; if not, the controller warns and stops.
Position check time	10.00 s	Maximum time allowed for the lifter to descend until the position-detect input becomes active.
Position up time	2.00 s	Time for which the torch rises after the position-detect input has become active. This sets the arc-ignition height.

Parameter	Default	Meaning
Speed to lock THC	95.00 %	Percentage of the full cutting speed below which the Lock THC output is switched on.
Distance to lock THC	5.00 mm	Within this distance of the start or the end of each cut segment the Lock THC output is switched on.
Time of disable THC after piercing	0.00 s	Delay between the arc-on feedback and the enabling of the height control.
Lose arc delay	0.00 s	Filter time for the loss-of-arc detection.
Time to lock THC before M08	100.00 s	The plasma is switched off this far before the end of the cut.
Pierce up time	2.50 s	Used with the dynamic pierce; see section 8.7.6.9.
Pierce down time	2.00 s	Used with the dynamic pierce; see section 8.7.6.9.
Watch arc enable	-	Yes: the arc-on feedback is watched continuously while cutting and the machine stops with an alarm if the arc is lost. No: the feedback is not watched during the cut.
Use cylinder THC	-	When ticked, the torch-down output is held on throughout the cut.
Set arc voltage	130 V	Reference arc voltage. Range 50.00 – 300.00 V.
Arc protection value	50 V	When the actual arc voltage reaches (Set arc voltage + Arc protection value) the controller reports a broken arc and stops. Range 5.00 – 100.00 V.
THC sensitivity	30.00 %	Response of the height-control motor. The faster the lifter, the higher the value. 30 to 50 is recommended; range 1.00 – 100.00.
Arc set step value	1.0 V	Step by which [F6] and [F7] change the set arc voltage. Range 0.10 – 10.00 V.
Fast IHS time	6.00 s	Time for which the lifter motor runs at full speed during initial height sensing. It then runs at half speed until the torch touches the plate.
Flame gun lift speed	100 %	Maximum lift speed of the flame torch, as a percentage.
Plasma gun lift speed	100 %	Maximum lift speed of the plasma torch, as a percentage.
Pierce / workpiece count, cut length, cut time, run time	0	Plasma production counters. Each can be cleared separately.

Notes.

- The controller also reports a broken arc whenever the arc voltage falls below 30 V. This 30 V threshold is fixed and cannot be changed.
- The Fast IHS time may not be longer than the Position check time.

7.4 Marker parameters

Parameter	Unit	Meaning
Marker ignition time	s	Ignition time of the marker. It uses the same output as the flame ignition.
Marker preheat time	s	Time from the end of the marker ignition to the opening of the powder.
Mix powder open time	s	Delay of the scattering nozzle relative to the opening of the spraying nozzle.
Mix powder close time	s	Delay of the scattering nozzle relative to the closing of the spraying nozzle.
Marker up time	s	Time for which the marker gun rises.
Marker down time	s	Time for which the marker gun descends.
Marker horizontal offset	mm	Horizontal offset of the marker gun relative to the cutting torch.
Marker vertical offset	mm	Vertical offset of the marker gun relative to the cutting torch.
Laser torch X offset to flame torch	mm	Horizontal distance of the laser cross from the flame torch.
Laser torch Y offset to flame torch	mm	Vertical distance of the laser cross from the flame torch.
Plasma torch X offset to flame torch	mm	Horizontal distance of the plasma torch from the flame torch.
Plasma torch Y offset to flame torch	mm	Vertical distance of the plasma torch from the flame torch.

7.5 System parameters

The system parameters cover the accuracy of the drives, the coordinate axes, the acceleration and the small-arc speed limit.

Parameter	Default	Meaning
Horizontal axis pulse	125 pulse/mm	Pulses the controller must generate to move the machine 1 mm along X. Up to three decimal places.
Vertical axis pulse	125 pulse/mm	Pulses the controller must generate to move the machine 1 mm along Y.
Max cutting speed	6000 mm/min	Highest cutting speed allowed.
Max G00 speed	6000 mm/min	Highest rapid-traverse speed allowed.
Max manual speed	6000 mm/min	Highest manual speed allowed.
Small arc limit	800 mm/min	Highest speed permitted while cutting a small arc. See note 1.
Limited speed below radius	0.00 mm	Arcs of this radius or smaller are cut at a limited speed. See note 1.
Accelerate time in flame	0.40 s	Time to accelerate from the starting speed to full speed in flame cutting.
Accelerate time in plasma	0.30 s	Time to accelerate from the starting speed to full speed in plasma cutting.
Emergency stop time	0.080 s	Time to decelerate from the present speed to standstill in an emergency.
Start speed	250 mm/min	Speed at which movement begins.
Max +X, Max +Y	100000 mm	Largest positive coordinate the machine can reach.
Min -X, Min -Y	-100000 mm	Largest negative coordinate the machine can reach.

Note 1 The small-arc speed limit

Cutting speed (mm/min)	Small arc radius (mm)
0 – 2 000	5
2 000 – 4 000	10
4 000 – 6 000	15
6 000 – 8 000	20
8 000 – 10 000	25
10 000 – 12 000	30
more than 12 000	35

Small arc limit	Limited speed below radius	Resulting cutting speed
= 0	= 0	No limit.
> 0	= 0	The table above applies: any arc smaller than the small-arc radius is cut at a limited speed.
> 0	> 0	Cutting speed = small arc limit × (arc radius / radius of small arc limit). If the result is lower than the starting speed the starting speed is used; if the starting speed is lower than the cutting speed the cutting speed is used.

A change to the small-arc limit or to the small-arc radius takes effect only after the cutting file has been reloaded.

7.6 Importing parameters

Press **[F6]** in the parameter screen and choose *Import from U disk* or *Import from the hard disk*.

- **From the USB stick.** Plug the stick into the front socket, select the parameter file and press **[ENTER]**. Only a file exported from a controller of the same model can be imported.
- **From the internal disk.** Make sure that a parameter file has been saved there, select it and press **[ENTER]**.

7.7 Exporting parameters

Press **[F7]** in the parameter screen and choose *Export to U disk* or *Export to the hard disk*. Give the file a name and press **[ENTER]**.

A practical use. Export one parameter set for each plate thickness you cut regularly and keep the files on the internal disk or on a USB stick. When the thickness changes, import the matching set instead of changing the parameters one by one.

7.8 Saving parameters

Press **[F8]** after any change. If the parameters are not saved the controller keeps working with the previous values.

7.9 Starting values for plasma cutting

The values below are a reasonable starting point for a machine fitted with the DynaCut ProX torch height controller. Trim them to suit the plasma source, the consumables and the plate.

Plasma parameter	Usual range	Starting value
Delay before arc	0	0
Pierce time	0 – 3 s	according to the plate thickness
Torch up time	0 – 3 s	3
Arcing check time	5 – 30 s	30
Position check time	3 – 30 s	15
Speed to lock THC	90 – 100 %	95
Distance to lock THC	0 – 15 mm	10
Lose arc delay	0 – 1 s	0.5
Watch arc enable	Yes / No	Yes

Chapter 8 Diagnostics and System Definition

Press **[F5]** (Diagnose) in the main screen. From this screen the inputs, the outputs and the keyboard can be tested, the controller can run a self-check, and the whole system definition can be reached.

Key	Function
[F1] Input	Input diagnosis.
[F2] Output	Output diagnosis.
[F5] KeyBrd	Keyboard diagnosis.
[F6] SelfCheck	System self-check.
[F7] DateTime	Set the date and the time.
[F8] SystemDef	System definition (parameter backup and recovery, port definition, language, update).

8.1 Input diagnosis

Press **[F1]**. The controller reads the state of every input and refreshes the screen. A green **NC** means that the input is active; a red **NO** means that it is inactive.

Function	Port	Function	Port
Forward limit	02	Move up input	09
Back limit	15	Move down input	10
Left limit	14	Move left input	07
Right limit	01	Move right input	08
Emergency stop	03	Acceleration input	16
Arc feedback	04	Deceleration input	17
IHS / position detect	05	Torch up input	18
Plasma collision	06	Torch down input	19

To test one input, short the corresponding pin of CN1 to 0 V (pin 13 or pin 25) and watch the indicator. If it changes, the input is sound; if it does not, redefine the port (section 8.7.2) or have the input examined.

8.2 Output diagnosis

Press **[F2]**. Move the cursor with the arrow keys, **[F3]** switches the selected output on and **[F4]** switches it off. A filled dot marks an active output.

Function	Port	Function	Port
Ignition	03	Blow / exhaust	06
Low preheat	01	THC enable	08
High preheat	17	IHS / plasma positioning	19
Pierce 1	04	Plasma arc start	16
Pierce 2	05	Lock THC (corner signal)	18
Pierce 3 (default)	14	Marker output	07
Torch up	02	Mix powder	20
Torch down	15	Marker preheat	21

To test one output, switch it on here and measure the voltage between the corresponding pin of CN2 and the common pin 12 or 24: DC 24 V must be present. If there is no voltage the output stage has failed.

8.3 Keyboard diagnosis

Press **[F5]**. Press any key on the keyboard and its code appears on the screen. If no code appears that key has failed.

8.4 System self-check

Press **[F6]**. The controller warns that:

1. the parameters should be backed up first;
2. the breakpoint will be lost;
3. the controller will restart after the check.

Confirm to run the check. *Self check pass* is displayed if everything is in order.

8.5 Date and time

Press **[F7]**, move the cursor to the date, the time or the weekday and adjust it with **[↑]** and **[↓]**.

8.6 System definition

Press **[F8]** in the diagnosis screen. Here the input and output ports, the coordinate system, the motor directions and the return-to-zero behaviour are defined, and the parameters can be backed up and restored.

Key	Function
[F1] ParaRecover	Restore the parameters from the backup.
[F2] ParaBackup	Back up the present parameters.
[F3] Define	Define the ports, the axes, the motors and the options.
[F4] Encrypt	Set the time-limit protection.
[F5] UnEncry	Remove the time-limit protection.
[F6] Language	Change the language of the user interface.
[F7] ClearFile	Delete every G code file in the controller.
[F8] Update	Update the system software from the USB stick.

8.6.1 Backing up and restoring the parameters

Backup. **[F5]** → **[F8]** → **[F2]**. Key in the code **1396** and press **[ENTER]**.

Restore. **[F5]** → **[F8]** → **[F1]**. Restart the controller after a successful restore.

The machine builder should back up the parameters as soon as the machine has been installed and commissioned.

8.6.2 Input definition

The number and the type of every input port can be changed. **[F5]** → **[F8]** → **[F3]** (password **1396**) → **[F1]**. Move the cursor with the arrow keys, press **[ENTER]** to open the drop-down box, choose the value with **[↑]** and **[↓]** and press **[ENTER]** again.

- Port numbers: 01 – 10 and 14 – 22.
- Type: NO (normally open) or NC (normally closed).
- Functions: move forward, move back, move left, move right, ignition, cutting oxygen, start, stop, torch up, torch down, acceleration, deceleration, Z-axis upper limit, Z-axis lower limit, drill enable, drive alarm.

8.6.3 Output definition

[F5] → [F8] → [F3] → [F2]. The procedure is the same as for the inputs. Every output is an open-drain transistor output. NO means that the output signal is normally open, NC that it is normally closed.

8.6.4 Coordinate definition

[F3] → [F3] (Axes). Press [ENTER] repeatedly to step through the eight possible orientations of the coordinate system and [F8] to save.

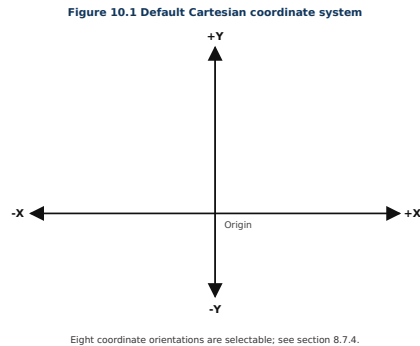


Figure 8.1 Default Cartesian coordinate system

8.6.5 Motor direction

[F3] → [F4] (Motor). Move the cursor to the axis whose direction is to be changed and press [ENTER] to reverse it. *XY exchange* set to Yes swaps the pulse trains of the X and Y axes, that is, it exchanges the horizontal and the vertical axis.

8.6.6 Option

[F3] → [F5] (Option).

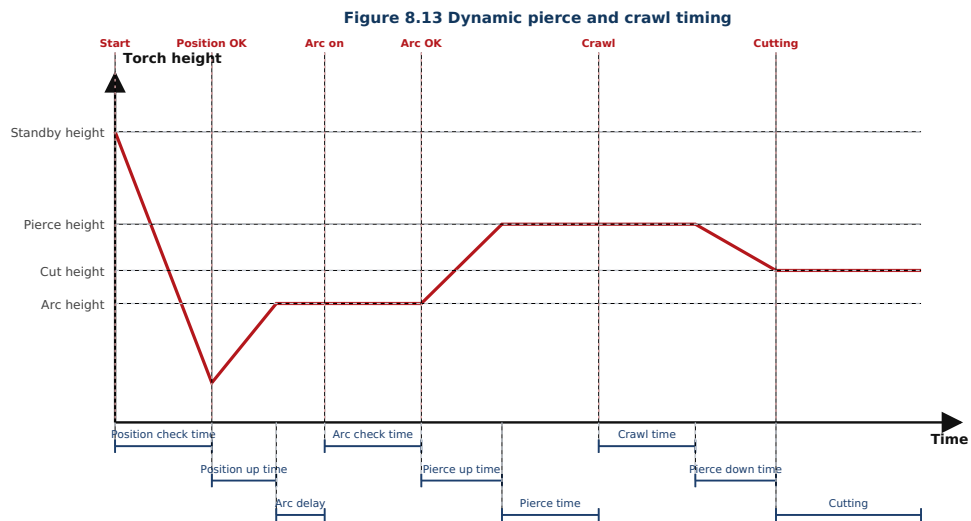
Option	Meaning
Remote controller type	NO (no remote control), P2P (one line per function) or 8421 (BCD coded). See section 11.1.2.
Coordinate type	Relative or absolute coordinates by default.
IJ coordinate type	Whether I and J after G02 or G03 are relative or absolute. Relative in almost every case.
Default unit	Metric or inch. Restart the controller after a change.
Fitting short line	Set to Yes when the G code contains a great many very short segments and the machine shakes. Normally No.
Steel angle remember	Yes: the plate-alignment angle is stored until the plate is aligned again or the angle is cleared. Normally No.
Forbidden F	Yes: the F word in the G code, which limits the rate, is ignored.
Save input angle as steel angle	Yes: an angle keyed in by hand (section 4.3.2) is also treated as the plate-alignment angle and shown in the main screen.
Use crawl in piercing	Yes: the dynamic pierce and crawl sequence is used. See section 8.6.7.
No plasma and steel contact check	No: a collision between the plasma torch and the plate stops the cut and raises an alarm. Yes: collision information is ignored while cutting.
Hold preheat after cutting end	Whether the preheat oxygen is shut off automatically when the job is finished.

CAUTION

If the machine starts to move by itself immediately after switching on, the remote controller type is almost certainly set wrongly. Set *Remote controller type* to **NO** unless a remote control is really fitted.

8.6.7 Dynamic pierce and crawl

With *Use crawl in piercing* set to Yes, the controller runs the sequence below. The time parameters are set in the plasma parameter screen; see section 7.3.

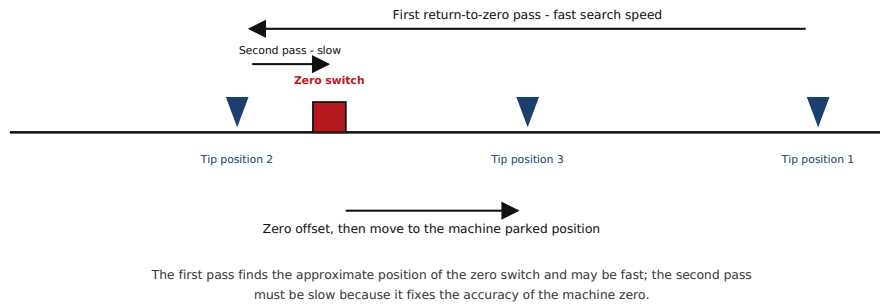


Stage	Behaviour
Position check time	The torch descends after the cut is started. The stage ends early as soon as the positioning-success signal is detected. If that signal has not arrived when the time has elapsed the controller raises an alarm. With the parameter set to 0 the check is skipped, the torch does not descend and the controller goes straight to the position-up stage.
Position up time	The torch rises for this time after the positioning signal has been detected. With the parameter set to 0 the torch does not rise and the controller goes straight to the arc-delay stage.
Arc delay	A pause before the arc is struck. With the parameter set to 0 the arc is struck at once.
Arc check time	The arc-start output is switched on and the arc-on feedback is watched. The stage ends early as soon as the feedback arrives. If it has not arrived when the time has elapsed the controller reports the error, stops cutting the present workpiece and leaves the program according to the breakpoint memory. With the parameter set to 0 the feedback is tested immediately and an error is reported at once if it is missing.
Pierce up time	The torch rises as soon as the arc has been established. With the parameter set to 0 the torch does not rise.
Pierce time	Stationary piercing. With the parameter set to 0 the stage is skipped.
Crawl time	Where the pierce has thrown up a lot of slag the arc is unstable, so the machine travels forward for this time with the height control held. With the parameter set to 0 the stage is skipped.
Pierce down time	At the end of the crawl the torch descends to the normal cutting height and cutting begins. With the parameter set to 0 the torch does not descend and normal cutting starts at once.

8.6.8 Option 2 and return to zero

[F3] → [F6] (Option 2).

Figure 8.15 Return-to-zero sequence



The machine first travels towards the zero switch at the first search speed. The first pass only finds the approximate position of the switch, so it may be fast. When the switch operates the machine stops just beyond it. It then reverses at the second, much lower, search speed; this pass fixes the accuracy of the machine zero. From the switch the machine runs to the machine zero according to the zero offset and finally to the parked position.

Parameter	Meaning
Axis select	The axis, X or Y, to which the settings below apply.
Back to zero sequence	1 or 2 – the order in which this axis returns to zero.
Back to zero enable	When ticked, this axis returns to zero; otherwise it does not.
Back to zero direction is positive	When ticked, the axis returns in the positive direction, otherwise in the negative direction.
First time seek zero speed	Speed of the first, coarse, search. May be relatively high.
Second time seek zero speed	Speed of the second, fine, search. Must be low for good accuracy.
Zero offset	Position of the real machine zero relative to the zero switch.
Machine parked position	Coordinate at which the axis parks when the return to zero is complete.
All the enabled axes back to zero together	When ticked, every enabled axis returns to zero at the same time; otherwise they return in the order set above.
Flame gun output selection	Whether the flame torch lifter is driven from CN5 or from the DB25 output CN2.
Demonstration mode output selection	Whether the lifter is driven from CN5 or from CN2 in demonstration mode.

CN5 and the two options above are available only on controllers fitted with the arc torch-height module.

8.7 Language, file clearing and software update

8.7.1 Changing the language

[F5] → [F8] → [F6] and choose the language.

8.7.2 Adding a language file

Copy the language file supplied by Cruxweld into the root directory of a USB stick and plug it into the front socket. In the system-definition screen move the cursor to *Add language file* and press [ENTER]; the result is reported on the screen.

8.7.3 Clearing the files

[F5] → [F8], move the cursor to *Clear file* and press [ENTER]. Every G code file in the controller is deleted.

8.7.4 Updating the system software

Plug in a USB stick that holds the upgrade file in its root directory, then press [F5] → [F8] → [F8] and confirm. Three choices are offered:

- **[F1] Function update** – update the application software.
- **[F2] Welcome update** – replace the welcome screen. The file must be named WELCOME.bmp and must lie in the root directory of the stick, not in a folder.
- **[F4] Factory setting** – return the controller completely to the state in which it left the works: parameters, port configuration and coordinate definition are all reset.

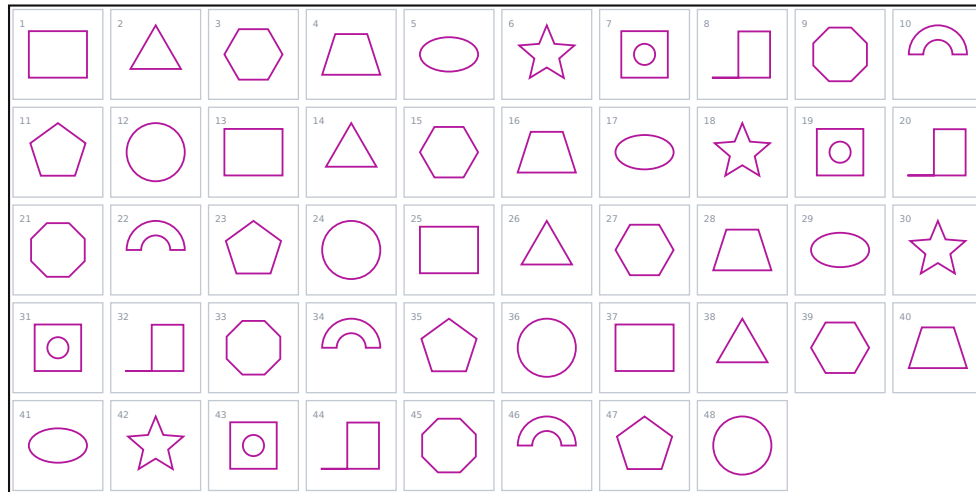
CAUTION

Do not use *Factory setting* in normal service. It erases the commissioning data of the machine. Back up the parameters first, and use the system recovery in the BIOS (Chapter 12) wherever possible, because that does not touch the user parameters.

Chapter 9 Shape Library

Press **[F1]** (ShapeLib) in the main screen. The library holds 48 common shapes; most of them can be cut either as a part or as a hole.

Figure 9.1 Shape library



Move the cursor with the arrow keys and press F8 to select a shape.

Move the cursor with **[↑]**, **[↓]**, **[←]** and **[→]** and press **[F8]** to select the shape.

9.1 Choosing a shape

When the shape has been selected, the size screen appears:

Field	Meaning
Lead in	Length of the lead-in, in millimetres.
Lead out	Length of the lead-out, in millimetres.
Size 1	First main dimension of the shape, marked 1 on the sketch.
Size 2	Second main dimension of the shape, marked 2 on the sketch.

Move between the fields with the arrow keys, key in the sizes and press **[F8]** to confirm. The controller then returns to the cutting screen with the shape loaded.

9.2 Part size and hole size

- **[F1] Inside** – the shape is cut as a hole, so the kerf is taken from the inside of the path.
- **[F2] Outside** – the shape is cut as a part, so the kerf is taken from the outside of the path.

The sizes are entered in the same way for both. Press **[F8]** to confirm and the controller moves to the cutting screen.

Shapes numbered above 29 in the library have no hole size.

9.3 Working with library shapes

- A library shape can be mirrored, rotated, scaled and arrayed in exactly the same way as a shape loaded from a G code file; see Chapter 4.
- The kerf set with **[N]** in the main screen is applied to the library shape as well.
- The library shape is stored on the internal disk under the name SHAPELIB/SHAPE_nn.TXT, so it can be loaded again later from the file manager and edited if required.
- Before cutting, use **[F3]** (Frame) in the cutting screen to run round the enclosing rectangle and check that the part fits on the plate.

Chapter 10 Programming Codes

10.1 Programming symbols

Symbol	Meaning
N	Block number.
G	Preparatory function.
M	Auxiliary function.
X	Relative or absolute coordinate of the X axis.
Y	Relative or absolute coordinate of the Y axis.
U	Relative coordinate of the X axis.
V	Relative coordinate of the Y axis.
I	X distance from the start of the arc to its centre.
J	Y distance from the start of the arc to its centre.
R	Radius of the arc. Positive when the arc is 180° or less, negative when it is more than 180°.
F	Rate, used with G01, G02 and G03.

In the descriptions that follow, “/” means *or*: X/U means that either X or U may be used, but not both. The letter n stands for the value that follows the address. Square brackets enclose an optional item.

10.2 Coordinate system

The controller uses the right-handed Cartesian coordinate system by default. The orientation can be redefined; see section 8.6.4.

10.3 G codes

Code	Parameters	Function
G99	X/U Y/V I J	Part options: scale, rotate, mirror.
G92	X Y	Set the reference point.
G91 / G90	none	Relative / absolute coordinates.
G20 / G21	none	Inch / metric units.
G41 / G42	none	Left / right kerf compensation.
G40	none	Cancel the kerf compensation.
G00	X/U Y/V	Rapid traverse in a straight line.
G01	X/U Y/V	Straight-line cutting.
G02	X/U Y/V I J	Clockwise circular cutting.
G03	X/U Y/V I J	Counter-clockwise circular cutting.
G04	P	Dwell.

G92 - reference point

Format: G92 [Xn] [Yn]

Xn and Yn are the absolute coordinates of the reference point, which is also the point to which the machine returns. With no parameters the reference point is (0, 0), and the code may then be omitted. The reference point set by G92 is stored automatically and survives a power failure. In one file G92 may appear only once.

G92 X0 Y0	the machine returns to (0, 0)
G92 X20 Y0	the machine returns to (20, 0)

G90 / G91 - absolute and relative coordinates

With **G90**, X and Y are absolute values while U and V remain relative. With **G91**, X, Y, U and V are all relative.

G92 X0 Y0	reference point (0,0)
G90	absolute coordinates
G00 X20 Y0	rapid to (20, 0)
M07	cutting device on
G01 X120 Y100	cut to (120, 100)
M08	cutting device off
M02	end of program

G92 X0 Y0	reference point (0,0)
G91	relative coordinates
G00 X20 Y0	rapid to (20, 0)
M07	cutting device on
G01 X120 Y100	cut to (140, 100)
M08	cutting device off
M02	end of program

G20 / G21 - units

G20 makes X, Y, I, J, R, U and V inches; **G21** makes them millimetres. If neither code appears the controller works in millimetres. 1 inch = 25.4 mm.

G00 - rapid traverse

Format: G00 X/Un Y/Vn [Fn]

- **Fn** - travel to the point at the stated rate.
- **Un, Vn** - displacement of the end point from the start of the present segment, in millimetres.
- **Xn, Yn** - in relative mode, displacement from the start of the present segment; in absolute mode, displacement from the working start point.

G01 - linear cutting

Format: G01 X/Un Y/Vn [Fn]

The parameters are the same as for G00. The difference is that G00 travels with every output closed while G01 cuts.

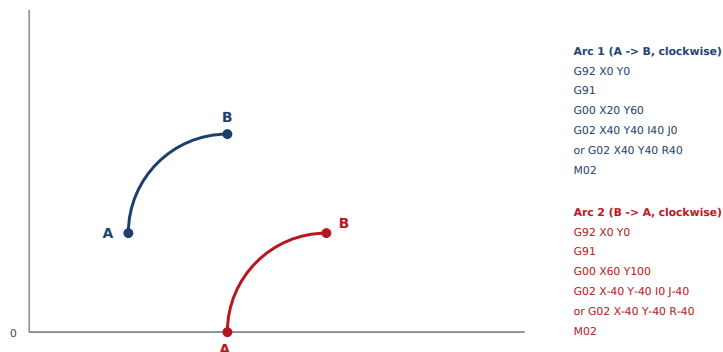
G02 / G03 - circular cutting

Format: G02 X/Un Y/Vn In Jn [Fn] or G02 X/Un Y/Vn R[-]n [Fn]

- **In** - X displacement of the centre from the start of the present segment.
- **Jn** - Y displacement of the centre from the start of the present segment.
- **R[-]n** - radius of the arc. R is positive when the arc is 180° or less and negative when it is larger.

G02 cuts clockwise and G03 counter-clockwise; in every other respect they are identical.

Figure 10.5 G02 / G03 circular interpolation example



G40 / G41 / G42 - kerf compensation

The path in the G code file is the true size of the workpiece, but flame and plasma cutting both remove a kerf. Kerf compensation makes the controller allow for the kerf so that the finished part is the right size.

G41 or G42 must always be paired with G40. If G41 or G42 is omitted the compensation is zero; if G40 is omitted the compensation stays switched on.

G41	enable left kerf compensation
...	cutting code
G40	cancel the compensation
G42	enable right kerf compensation
...	cutting code
G40	cancel the compensation

A complete example – a trapezium with a hole:

G21	metric units
G91	relative coordinates
G99 X1 Y0 I0 J0	scale 1, no rotation, no mirror
G00 X44.45 Y41.275	rapid to the hole
G41	left kerf compensation
M07	cutting on
G03 X0 Y0 I19.05 J0	cut the hole
M08	cutting off
G40	cancel compensation
G00 X-44.45 Y-41.275	rapid back
G41	right kerf compensation
M07	cutting on
G01 X25.779438 Y58.031634	
G02 X75.441125 Y0 I37.720562 J-16.756634	
G01 X25.779438 Y-58.031634	
G01 X-127 Y0	
M08	cutting off
G40	cancel compensation
M02	end of program

Set the kerf value to **half** of the real kerf width.

G99 - scale, rotate and mirror

Format: G99 Xn Yn In Jn

- **X** – scale factor, 0.001 to 1000.
- **Y** – rotation angle, -360° to $+360^\circ$.
- **I** – mirror about the X axis; 1 mirrors, 0 does not.
- **J** – mirror about the Y axis; 1 mirrors, 0 does not.

G99 is optional, but if it is present none of X, Y, I and J may be left out. Mirroring and rotation are referred to the origin (0, 0).

G04 - dwell

Format: G04 Pn. P is the dwell in units of 0.01 s, so P100 is a dwell of one second.

10.4 Rules for writing a program

- Every program must contain G92 (reference point) and M02 (end of program).
- G41 and G42 must be paired with G40. If G41 or G42 is missing the compensation is zero; if G40 is missing the compensation stays on.
- If G20 and G21 are both missing the controller works in metric units.
- If G90 and G91 are both missing the controller works in relative coordinates.
- M07 and M08 may not be omitted.
- If a parameter is missing from G00, G01, G02 or G03, the controller uses the value of the previous line when the coordinate is absolute, and zero when it is relative.
- G00, G01, G02 and G03 may be shortened to G0, G1, G2 and G3.
- When several consecutive lines use the same motion code, the code may be omitted from all but the first.

10.5 M codes

Code	Parameters	Function
M07	none	Cutting device on. The whole ignition, preheat and pierce cycle is executed; see Appendix 2.
M08	none	Cutting device off, followed by the torch-up and blow stages; see Appendix 2.
M09	none	Powder on.
M10	none	Powder off.
M11	none	Marker offset on.
M12	none	Marker offset off.
M00	none	Program stop. The machine halts and waits for the next operation.
M02 / M30	none	End of program.

10.6 A complete short program

A 200 mm square with a 5 mm lead-in, cut with left kerf compensation:

```

G21          metric
G91          relative coordinates
G92 X0 Y0    reference point
G00 X50 Y50  rapid to the lead-in start
G41          left kerf compensation
M07          cutting on
G01 X5 Y0    lead in
G01 X200 Y0  bottom edge
G01 X0 Y200  right edge
G01 X-200 Y0 top edge
G01 X0 Y-200 left edge
G01 X-5 Y0   lead out
M08          cutting off
G40          cancel compensation
M02          end of program

```

Compile any program you have written or edited with **[F1]** in the editor before you use it. The compiler reports the first illegal line, which saves a spoiled plate.

Chapter 11 Ports and Wiring

All the connectors are on the rear of the controller. CN1 is the input port, a DB25 male; CN2 is the output port, a DB25 female; CN3 is the motor port, a DB15 male. CN4 and CN5 belong to the arc torch-height module. The three-pin green terminal at the bottom is the 24 V supply input.

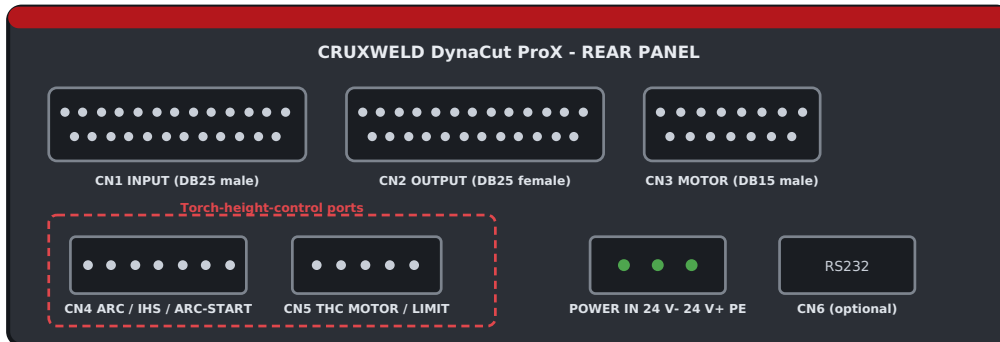
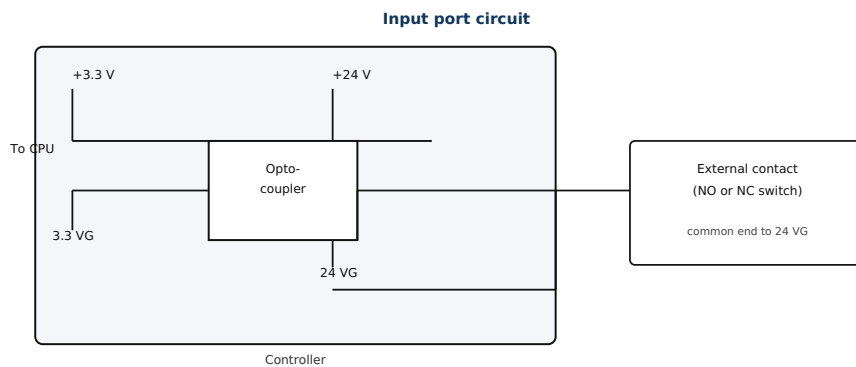


Figure 11.1 Rear panel

11.1 Input port CN1

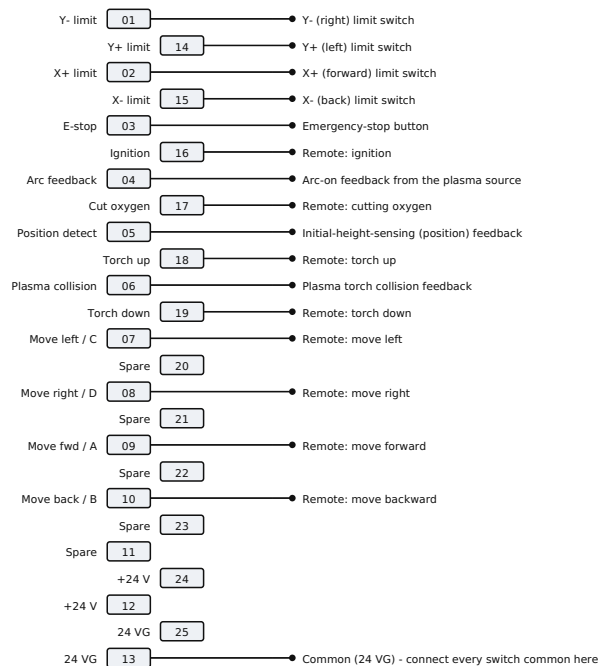


- The input signal comes from a mechanical contact; normally open and normally closed types are both supported.
- An input is active when it is connected to 24 VG and inactive when it is left floating or connected to +24 V.
- The common terminal of the external switches must go to 24 VG; the other terminal goes to the input pin.
- There are sixteen input channels in all.

Pin	Signal	Remark
2	X+ limit	X+ stop input, horizontal axis. Leave floating if not used.
15	X- limit	X- stop input, horizontal axis. Leave floating if not used.
14	Y+ limit	Y+ stop input, vertical axis. Leave floating if not used.
1	Y- limit	Y- stop input, vertical axis. Leave floating if not used.
3	Emergency stop	Leave floating if not used.
4	Arc on, successful	Arc-on feedback from the plasma source.
5	Positioning successful	Initial-height-sensing feedback.
6	Plasma collision	Torch collision feedback.
7	Move left / C	Remote control input.
8	Move right / D	Remote control input.
9	Move forward / A	Remote control input.
10	Move backward / B	Remote control input.
16	Ignition	Remote control input.
17	Cutting oxygen	Remote control input.
18	Torch up	Remote control input.
19	Torch down	Remote control input.
11, 20-23	Spare	-
12, 24	+24 V	+24 V / 3 A power output.
13, 25	24 VG	+24 V ground.

11.1.1 Input wiring

Figure 11.3 External input wiring (CN1, DB25 male)



All inputs may be configured normally open or normally closed; the factory setting is normally open.
 An input is active when it is pulled down to 24 VG, and inactive when it is left floating or tied to +24 V.
 Unused inputs may be left unconnected.

11.1.2 Remote control inputs

Three kinds of remote control are supported: a point-to-point (P2P) line input, an 8421 (BCD) coded input and an RS232 serial input.

Point-to-point. Pins 7, 8, 9 and 10 are left, right, forward and backward: while the input is active the machine moves in that direction and it stops when the input goes inactive. Pin 16 fires the ignition for the ignition time set in the flame parameters. Pin 17 toggles the cutting oxygen: if the oxygen is on it is turned off, and if it is off it is turned on. Pin 18 raises and pin 19 lowers the torch while the input is active.

The switches of a point-to-point remote control are supplied by the machine builder.

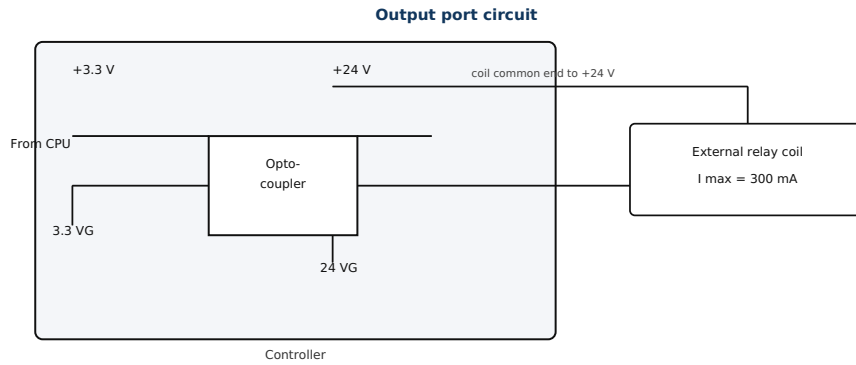
8421 (BCD) code. Pins 9, 10, 7 and 8 carry the A, B, C and D bits.

Decimal	8421 code (DCBA)	Function
0	0000	No input
1	0001	Turn the cutting oxygen on or off
2	0010	Move back along the path
3	0011	Move forward along the path
4	0100	Move left
5	0101	Ignition
6	0110	Start
7	0111	Slow down
8	1000	Speed up
9	1001	Move in the negative direction vertically
10	1010	Move forward vertically
11	1011	Pause
12	1100	Lower the cutting torch
13	1101	Raise the cutting torch
14	1110	Move right horizontally
15	1111	Start

RS232 serial. See Chapter 14.

Set *Remote controller type* in the option screen (section 8.6.6) to match the remote control actually fitted, and to **NO** when none is fitted.

11.2 Output port CN2



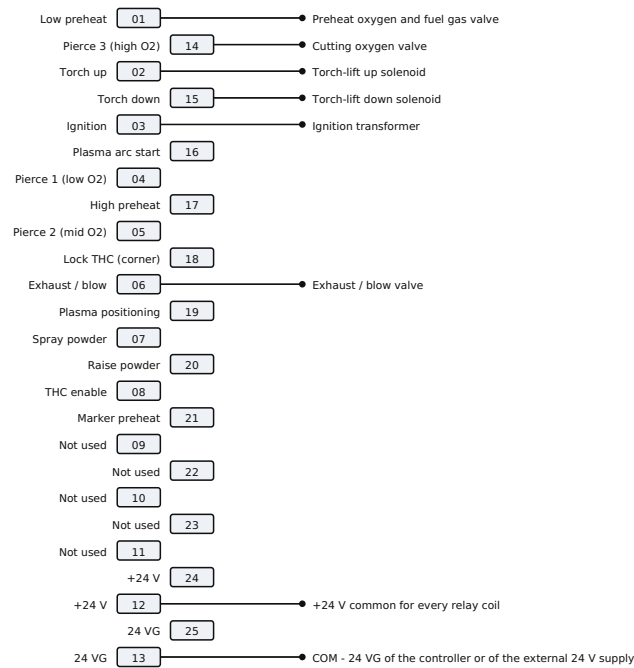
- The outputs work at 24 V DC and are active low.
- One end of the external relay coil goes to +24 V and the other to the output pin.
- Maximum output current 300 mA.
- There are sixteen output channels in all.

Pin	Signal
3	Ignition
1	Low-pressure preheat
17	High-pressure preheat
4	Low-pressure cutting oxygen (pierce 1)
5	Medium-pressure cutting oxygen (pierce 2)
14	High-pressure cutting oxygen (pierce 3)
2	Torch up
15	Torch down
6	Exhaust / blow
8	Enable the height control box
19	Plasma positioning
16	Plasma arc start
18	Corner low-speed output, or auto / manual
7	Spray powder
20	Raise powder
21	Marker preheat
9, 10, 11, 22, 23	Not used
12, 24	+24 V / 3 A output
13, 25	+24 V ground

Take the supply for the external relays from pins 12 and 24 of CN2 and the ground from pins 13 and 25.

11.2.1 Typical oxy-fuel connection

Figure 11.5 Typical oxy-fuel connection (CN2, DB25 female)



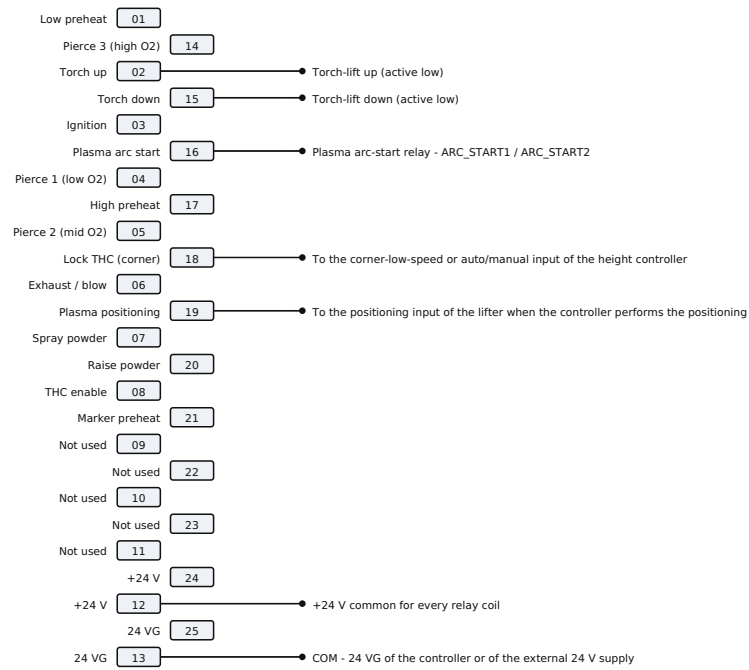
Every output is an open-collector transistor output, active low by default, $I_{max} = 300 \text{ mA}$.

Take the +24 V for the relay coils from pins 12 / 24 and the 24 V ground from pins 13 / 25.

Outputs can be redefined as active high in the output-definition screen (see section 8.7.3).

11.2.2 Typical plasma connection

Figure 11.6 Typical plasma connection (CN2, DB25 female)



An isolating relay in the arc-start line is strongly recommended; it keeps the high-frequency start pulse of the plasma source out of the controller.

11.2.3 Working with a separate height controller

With a corner-low-speed input. When the height controller takes a corner-low-speed input, use the *corner low speed* output of the controller to drive it. The output is an open-collector transistor output, active low by default. Set the type of the *Lock THC* (corner signal) output to **NO** in section 8.6.3. The controller then outputs a low level while the rate is being reduced and releases the signal during normal cutting.

With an auto / manual input. When the height controller takes an auto / manual signal instead of a corner-low-speed input, use the same output but set its type to **NC** in section 8.6.3. The controller then releases the signal while the rate is being reduced and outputs a low level during normal cutting.

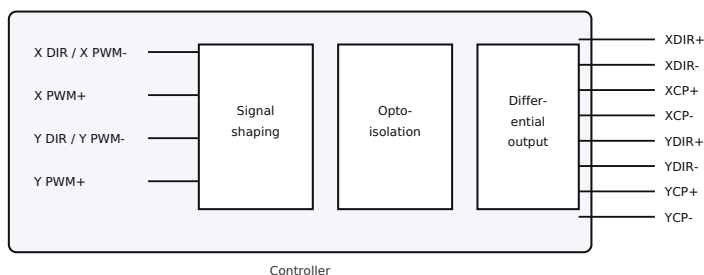
Positioning performed by the height controller. Switch the positioning function of the controller off by setting the type of the *Position detect* input to **NC** in section 8.6.2. Two arrangements are common:

1. **Positioning triggered by the arc-start command.** The controller issues the plasma arc-start signal; the height controller performs the positioning, strikes the arc and returns the arc-on feedback. The controller begins to cut as soon as that feedback arrives. Connect the *plasma arc start* output of the controller to the *arc start with positioning* input of the height controller, and set the *Arcing check time* plasma parameter long enough to cover both the positioning and the arc start.
2. **Positioning by lowering the torch first.** Before the arc-start command is issued, the controller issues the torch-down command and only then the arc-start command. Set the *Position check time* plasma parameter to the time needed for the torch to reach the plate.

Positioning performed by the controller. Set the type of the *Position detect* input to **NO** in section 8.6.2, wire the positioning-success signal back to that input, and set the *Position check time* and *Position up time* plasma parameters to suit the lifter.

11.3 Motor port CN3

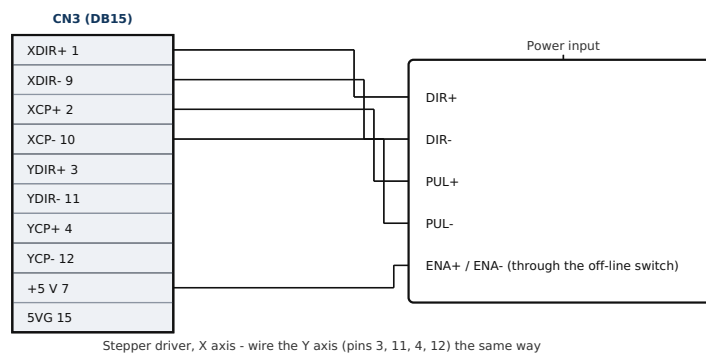
Figure 11.7 Motor port schematic (CN3, DB15 male)



Pin	Signal	Remark
1	XDIR+	Direction, horizontal axis, positive
9	XDIR-	Direction, horizontal axis, negative
2	XCP+	Pulse, horizontal axis, positive
10	XCP-	Pulse, horizontal axis, negative
3	YDIR+	Direction, vertical axis, positive
11	YDIR-	Direction, vertical axis, negative
4	YCP+	Pulse, vertical axis, positive
12	YCP-	Pulse, vertical axis, negative
5, 6, 13, 14	Not used	-
7	+5 V	+5 V / 500 mA power output
8, 15	5 VG	5 V power ground

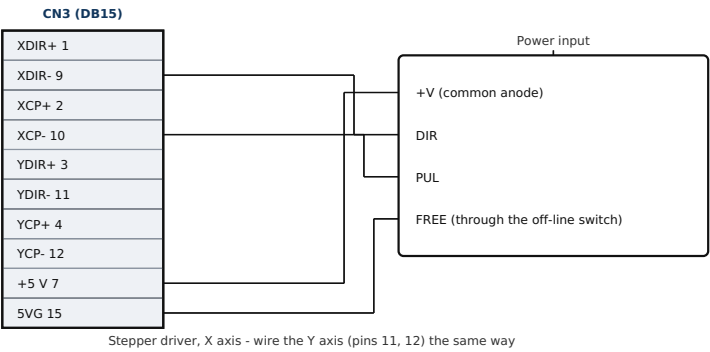
11.3.1 Differential stepper driver

Figure 11.8 Differential stepper driver connection



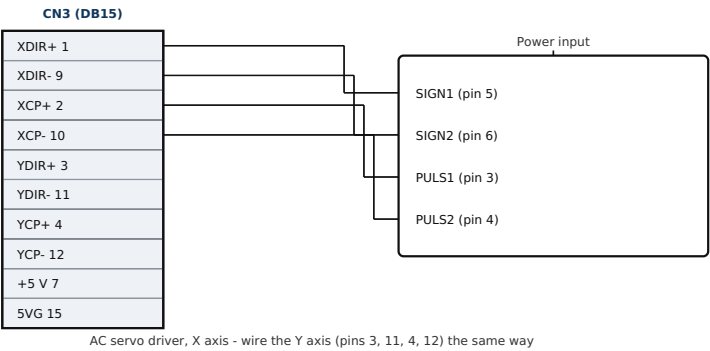
11.3.2 Common-anode stepper driver

Figure 11.9 Common-anode stepper driver connection



11.3.3 Servo driver

Figure 11.10 Servo driver connection (pulse + direction)



11.4 Arc torch-height module, CN4 and CN5

11.4.1 Torch height motor port CN5

MOTOR_1 and MOTOR_2 go to the height-adjustment motor; UP_LIMIT and DOWN_LIMIT go to the upper and lower limit switches; COM is the 24 V power ground.

CN5	Signal	Remark
1	DOWN_LMT	Lower limit switch input
2	UP_LMT	Upper limit switch input
3	COM	+24 V power ground
4	MOTOR_1	Height-adjustment motor
5	MOTOR_2	Height-adjustment motor

Maximum motor power 45 W. If no limit switches are fitted, link DOWN_LMT to COM and UP_LMT to COM.

11.4.2 Arc input

CN4	Signal	Remark
4	ARC–	Negative output of the arc-voltage divider board
5	ARC+	Positive output of the arc-voltage divider board

The factory setting of the division ratio is 100 : 1. To use a 50 : 1 divider board, open the enclosure and set the internal ratio switch to ON; OFF gives 100 : 1.

11.4.3 Initial height sensing port

The positioning port and the arc input share the seven-pin connector CN4. +24 V (OUT) goes to the positive lead of the proximity switch, SIGNAL to its signal lead and COM to its negative lead. The proximity switch must be an NPN type for DC 24 V.

CN4	Signal	Remark
1	COM	Negative pole of the proximity switch (blue)
2	SIGNAL	NPN proximity switch signal (black)
3	+24 V (OUT)	Positive pole of the proximity switch (brown)

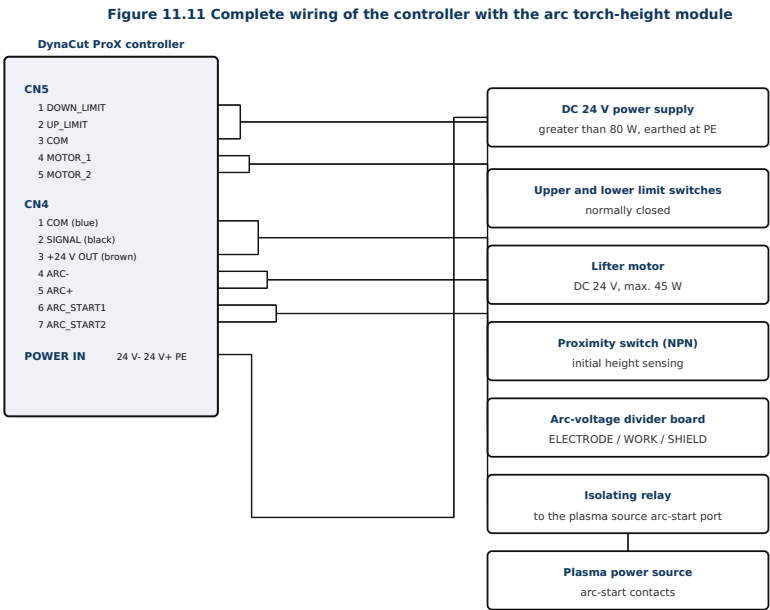
11.4.4 Arc start output

CN4	Signal	Remark
6	ARC_START1	Plasma source arc-start contact, + side
7	ARC_START2	Plasma source arc-start contact, – side

IMPORTANT

Fit an isolating relay in the arc-start line. It keeps the high-frequency start pulse of the plasma source out of the controller and prevents both nuisance stops and damage.

11.4.5 Complete wiring with the arc torch-height module

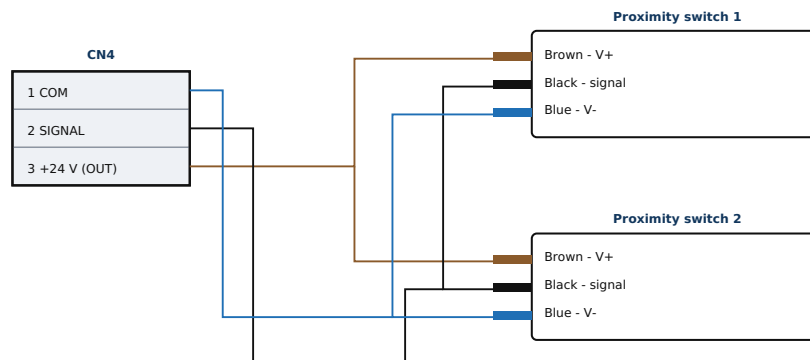


An isolating relay in the arc-start line keeps the high-frequency start pulse of the plasma source out of the controller and is strongly recommended.

11.4.6 Two proximity switches

Two NPN proximity switches may be used for the positioning, connected either in parallel or in series. Series connection gives the most accurate and the most stable positioning and is recommended.

Figure 11.12 Two proximity switches wired in series



Both switches are normally closed. If either switch operates the signal path opens and the controller reports a collision. Series wiring gives the most stable and most accurate positioning.

11.4.7 Separate control of the flame torch and the plasma torch

The flame torch and the plasma torch can be lifted independently. The plasma torch can be connected only to the CN5 motor port; the flame torch can be driven either from CN5 or from the DB25 output CN2, as chosen by the *Flame gun output selection* parameter (section 8.6.8). For CN5 follow section 11.4.1; for CN2 follow section 11.2.

11.5 Power input

Pin	Signal	Remark
1	24 V–	24 V supply, negative
2	24 V+	24 V supply, positive
3	PE	Protective earth

WIRING RULES

- Use a 24 V supply rated at more than 80 W for the controller alone.
- Bond PE to the machine earth with a short, heavy conductor. Good earthing is the single most effective measure against interference from the plasma source.
- Run the arc-voltage cable, the motor cables and the signal cables in separate ducts, away from the plasma power leads and the work return.
- Use screened cable for the arc-voltage signal and bond the screen at the controller end only.
- Never take the arc-voltage signal directly from the electrode and the workpiece; always take it from the divider board.

Chapter 12 Using the BIOS

When the controller is switched on it shows the BIOS start-up screen and counts down from three. Press **[F2]** during the countdown to enter the BIOS. Any other key skips the countdown and starts the application.



Figure 12.1 BIOS start-up screen

Key	Function
[F1]	Update the system software.
[F4]	Back up the system.
[F5]	Restore the system.
[F6]	Start the system.
[F8]	Upgrade the BIOS itself.

12.1 System update

Press **[F1]** in the BIOS. Two conditions must be met:

- a USB stick is plugged into the front socket of the controller;
- the upgrade file supplied by Cruzweld lies in the root directory of that stick.

When the update is finished press **[F6]** to restart.

12.2 System backup

Press **[F4]** in the BIOS. Only the operating system is backed up; the parameters, the port configuration and the coordinate definition are not.

12.3 System recovery

Press **[F5]** in the BIOS to return to the operating system that was backed up. Recovery from the BIOS does not touch the user parameters, the port configuration or the coordinate definition, so it is the safest way of recovering a controller whose software has been damaged.

Prefer the BIOS recovery to the *Factory setting* option described in section 8.7.4. The factory setting erases the commissioning data of the machine as well as the software.

Chapter 13 Installation and Commissioning

13.1 Mechanical installation

1. Cut the panel aperture to the size given in Appendix 4 and fit the controller from the front.
2. Leave at least 50 mm of clear space behind the controller for the connectors and the cables.
3. Mount the controller in a cabinet that keeps dust and cutting fume away from it, and away from sources of strong high-voltage radiation.
4. Bond the PE terminal to the machine earth with a short, heavy conductor.

13.2 Setting the pulses per millimetre

The horizontal and vertical pulse numbers are system parameters (section 7.5). They are set as follows.

1. Assume a value for the horizontal pulses, XPIs, and for the vertical pulses, YPIs, and save them.
2. Enter the manual screen and choose step moving. Set the step distance to A mm.
3. Move A mm along the horizontal axis and measure the real distance travelled, B mm. The corrected pulse number is

$$XPIs_{new} = XPIs \times A / B$$

4. Repeat on the vertical axis: move C mm, measure D mm, and set $YPIs_{new} = YPIs \times C / D$.
5. Round the result to three decimal places and save the parameters.

13.3 Checking the pulse rate

The highest pulse frequency the controller produces is 160 kHz. Above that the machine cannot follow the program. With a pulse number x and a maximum speed Mv in mm/min,

$$Mv \times x / 60 < 160\,000$$

For example, with $x = 2000$ and $Mv = 12\,000$ mm/min, $12\,000 \times 2000 / 60 = 400\,000$, which is far above the limit, so 12 000 mm/min cannot be reached. With $x = 500$, $12\,000 \times 500 / 60 = 100\,000$, which is below the limit, so the machine can run at 12 000 mm/min.

In principle the pulse number may be large, but in practice it should lie between **150 and 1200**. A very high frequency makes some drives lose step and makes the system more sensitive to interference. If the calculated value falls outside this range, change the micro-step setting of the stepper driver, or the electronic gear ratio of the servo driver, instead.

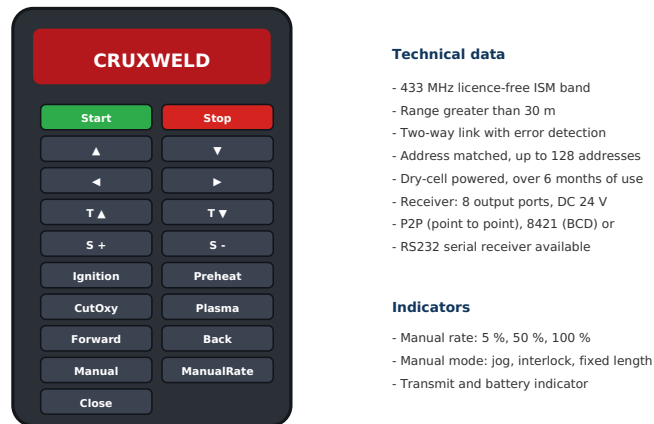
13.4 Commissioning checklist

1. Check the supply: DC 24 V, more than 80 W, PE bonded.
2. Run the input diagnosis (section 8.1) and operate every limit switch, the emergency stop and the proximity switch by hand; confirm that each indicator changes.
3. Run the output diagnosis (section 8.2) and confirm that every valve and relay operates.
4. Set the motor directions and, if necessary, exchange X and Y (section 8.6.5).
5. Set the pulses per millimetre as described above.
6. Set the soft limits Max +X, Max +Y, Min -X and Min -Y to the real travel of the machine.
7. Set the acceleration times and the starting speed; raise them only as far as the machine runs without shaking.
8. Set the process parameters for the plate you will cut most often.
9. Set up the return to zero if zero switches are fitted (section 8.6.8).
0. **Back up the parameters** (section 8.6.1).

Chapter 14 Wireless Remote Control

A wireless remote control is available for the DynaCut ProX. It consists of a hand-held transmitter and a receiver that is wired to the controller.

Figure 14.1 Wireless remote-control handset



14.1 Performance

- 433 MHz licence-free ISM band.
- Range greater than 30 m, and never less than 0.5 m.
- Hardware error detection and a software optimising algorithm, with a two-way link, keep the communication stable and reliable.
- Transmitter and receiver are matched by address; the address is set by hand and up to 128 addresses are supported.
- The transmitter is powered by dry cells that last more than six months.
- The receiver can be set to 8421 mode or to I/O mode and has up to 16 output ports.
- A serial receiver that plugs into the RS232 port CN6 is also available. The RS232 port is not fitted as standard and must be specified with the order.

14.2 The transmitter

The handset has nineteen keys: Start, Stop, the four direction keys, Manual, T ↑, T ↓, S +, S -, Ignition, Preheat, CutOxy, Plasma, Forward, Back, Close and ManualRate.

Six indicators show the manual rate (5 %, 50 %, 100 %) and the manual mode (jog, interlock, fixed length); one indicator shows that a signal is being transmitted and one shows the battery state.

At switch-on the manual rate is 50 % and the manual mode is jog. Each press of ManualRate steps the rate 50 % → 100 % → 5 % → 50 %. Each press of Manual steps the mode jog → interlock → fixed length → jog.

14.3 Key codes

While a key is held down the receiver produces the code below on OUT1 to OUT8; when the key is released every output is switched off. A 0 means that the output is driven high and a 1 that it is driven low.

Key	P2P output	Coded output	Remark
S+ / Speed	00001000	00001000	Speed up
S- / Speed	00000100	00000111	Speed down
↑	00100000	00001010	Up
↓	00010000	00001001	Down
←	01000000	00000100	Left
→	10000000	00001110	Right
Manual once	-	00001111	Manual cycles between once, twice and three times
Manual twice	-	00011111	
Manual three times	-	00101111	
T↑	-	00001101	Torch up
T↓	-	00001100	Torch down
Start	00000010	00000110	Start
Stop	00000001	00001011	Stop
Back	-	00000010	Back along the path
Forward	-	00000011	Forward along the path
Ignition	-	00000101	Ignition
CutOxy	-	00000001	Cutting oxygen
Preheat	-	00110000	Preheat oxygen
Plasma	-	01000000	Plasma arc
Manual rate once	-	01010000	Cycles between the three rates
Manual rate twice	-	01100000	
Manual rate three times	-	01110000	
Close	-	11110000	All off

14.4 The receiver

- Eight output ports.
- Supply 24 V DC.
- Each output has its own LED, which lights while the output is on.

Wire the eight receiver outputs to the corresponding inputs of CN1 as listed in section 11.1.2, then set the remote controller type: **[F5]** (Diagnose) → **[F8]** (System definition) → **[F3]** (Definition) → **[F5]** (Option), and set *Remote controller type* to **8421** (or to **P2P** for a point-to-point receiver).

14.5 Serial receiver

The serial receiver plugs straight into the nine-pin RS232 socket CN6 on the rear of the controller, either directly or through a male-to-female DB9 extension lead.

Receiver (female)	CN6 (male)	Signal
2	2	RXD
3	3	TXD
4	4	+5 V
5	5	5 VG

The RS232 port is not fitted as standard. Ask for it when the order is placed; it cannot be added in the field, because extra hardware has to be built into the controller.

CAUTION

- Set *Remote controller type* to **NO** whenever no remote control is fitted. If it is left set, the four direction inputs may read as active and the machine can start to move on its own as soon as it is switched on.
- Keep the remote control with the operator, never on the machine, so that the emergency stop and the remote control cannot be separated from the person who is watching the cut.

Chapter 15 Tube and Plate Module

15.1 Introduction

The tube and plate module is a software option for the DynaCut ProX that lets the same controller cut pipe as well as plate. It is built on the same proven platform, so it is equally stable and equally simple to operate, and an operator who can already run the controller on plate can begin cutting pipe almost at once.

Functions

- Two-axis tube cutting machines with a chuck.
- Two-axis tube cutting machines with a friction disc.
- Tube and plate combination machines, with a chuck or with a friction disc.
- Automatic change-over between tube cutting and plate cutting.
- Any pipe diameter, using nesting software on the computer, for cut-offs, saddles, eccentric saddles, lobster-back bends and elbows.
- A built-in tube graphics library with five basic shapes – left and right cut-off, left and right branch and mother-pipe opening – which may be combined freely.

15.2 Main screen and mode change

The main screen is the same as in plate cutting with one addition: between the graphic area and the code area the tube diameter is shown, for example D: 200.00, meaning a tube of 200 mm outside diameter.

The common parameter screen carries one extra parameter, *System mode*. Press **[F4]** (Setups) → **[F1]** (Common), move to *System mode* with **[↑]** and **[↓]**, and change between **Tube cutting** and **Plate cutting** with **[←]** and **[→]**.

After the system mode has been changed, save the parameters and switch the controller off and on again. Only then does the controller change over between tube cutting and plate cutting.

15.3 Tube graphics library

Press **[F1]** in the main screen. The library screen lists the end types that can be cut. Choose them in order in the drop-down boxes on the left; the combination is free.

Key	Function
[F1] Para edit	Edit the parameters of the end type at the cursor. When several ends are combined, the pipe diameter and the wall thickness can be set only in the first drop-down box.
[F2] Delete	Delete the end at the cursor. The first end cannot be deleted.
[F3] Add	Add an end type at the cursor.
[F8] Enter	Confirm the parameters and go to the graphic preview.

Move between the drop-down boxes with **[↑]** and **[↓]**, and open a box with **[ENTER]** or **[F2]**. Every end must have its parameters set; an end whose parameters are still unset is shown in red.

This chapter applies only to a controller fitted with the tube and plate module.

15.4 Parameters of the end types

15.4.1 Cut-off

Parameter	Unit	Meaning
Pipe diameter	mm	Outside diameter of the pipe being cut. Can be set only in the first drop-down box.
Wall thickness	mm	Wall thickness of the pipe. Can be set only in the first drop-down box.
Cut-off angle	degrees	Angle between the pipe axis and the cut face.
Rotation angle	degrees	Angle through which the chuck axis is turned relative to the datum point. Counter-clockwise, seen from the pipe end towards the chuck, is positive.
Cut-off length	mm	For the first end of a combination, the distance from the torch point to the intersection with the centre line. For a later end, the distance between the intersection of the previous end and the intersection of the present end with the axis.
Groove angle	degrees	Bevel angle on the cut face.
Lead-in angle	degrees	Angle of the lead-in.
Lead-in length	mm	Length of the lead-in.
Lead-out length	mm	Length of the lead-out.

15.4.2 Branch

Parameter	Unit	Meaning
Branch pipe diameter	mm	Outside diameter of the pipe being cut. First drop-down box only.
Branch pipe wall thickness	mm	Wall thickness of the pipe being cut. First drop-down box only.
Mother pipe diameter	mm	Diameter of the pipe into which the branch runs.
Angle	degrees	Angle between the branch and the mother pipe.
Cut-off length	mm	Distance from the torch point to the intersection of the branch with the centre line, as for the cut-off.
Rotation angle	degrees	As for the cut-off.
Eccentricity	mm	Perpendicular distance between the centre line of the branch and the centre line of the mother pipe.
Lead-in angle, lead-in length, lead-out length	-	As for the cut-off.

15.4.3 Mother-pipe opening

The opening in the mother pipe may be of the riding type or of the plug-in type; the type is chosen in the drop-down box below the sketch.

Parameter	Unit	Meaning
Mother pipe diameter	mm	Outside diameter of the pipe being cut. First drop-down box only.
Mother pipe wall thickness	mm	Wall thickness of the pipe being cut. First drop-down box only.
Branch pipe diameter	mm	Diameter of the branch that is to be inserted.
Angle	degrees	Angle between the branch and the mother pipe.
Cut-off length	mm	As for the branch.
Rotation angle	degrees	As for the cut-off.
Eccentricity	mm	As for the branch.
Dynamic bevel angle	degrees	Bevel angle of the mother-pipe opening.
Lead-in angle, lead-in length, lead-out length	-	As for the cut-off.

15.5 Graphic preview

When the parameters of the chosen shape have been set, press **[F8]**. The preview screen shows the code generated from the end types and the parameters. In the upper right corner an edit box carries the name of the G code file that will be produced; the name can be changed. Press **[F8]** to save the file. It can then be found again at any time with **[F2]** (Files) in the main screen. Press **[F8]** once more to return to the main screen, where cutting can be started.

15.6 Tube-cutting parameters

The system parameter screen carries two extra parameters for tube cutting.

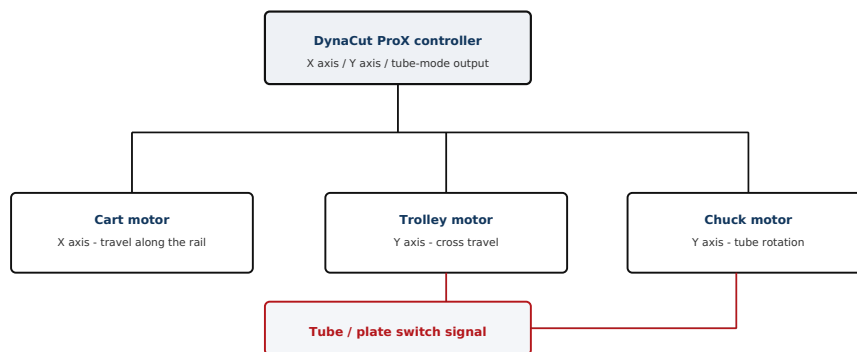
Parameter	Unit	Meaning
Chuck pulse	pulses / degree	Number of pulses needed to turn the chuck through one degree. The controller uses it to work out the chuck position in tube-cutting mode.
Chuck max speed	rev/min	Highest speed of the chuck.

The option screen - **[F5] → [F8] → [F3] → [F5]** - carries two more:

Parameter	Meaning
Use chuck	Yes when the rotating axis uses a chuck, No when it uses a friction disc.
Pipe axes output	Whether the chuck is driven by the X axis or by the Y axis.

15.7 Machine topology

Figure 15.1 Tube / plate all-in-one topology



Only one of the trolley motor and the chuck motor is enabled at any time; the tube-mode output of the controller performs the change-over.

The X and Y outputs drive the cart and the trolley. The chuck motor may be driven from either axis. Only one of the trolley motor and the chuck motor is enabled at a time; the change-over is made by the *Pipe mode* output of the controller.

15.8 I/O in tube mode

The output definition screen carries one extra function in place of the powder output:

Function	Port	Meaning
Pipe mode	20	Held open throughout tube cutting and held closed throughout plate cutting. Use this signal to switch the enable between the trolley and the chuck.

15.9 Tube-cutting code

A tube-cutting program is written very much like a plate-cutting program. The differences are these.

Address	Meaning in tube mode
X	The cart axis, in millimetres.
Y	The chuck, in degrees. Where no chuck is used, in millimetres. In plate mode Y is the trolley.

Diameter. A tube-cutting program must begin with the diameter as a comment, for example (D=168), which means that the pipe is 168 mm in diameter.

Wall thickness. A line such as (T=8) may be included and means that the wall is 8 mm thick. It is optional.

Comments. Anything in brackets is a comment. Apart from the diameter line, every comment may be left out.

A typical tube program

```
(D=452)
(T=55)
(M=Q235-A)
(F=1)
G71
G90
G92 X0 Y0
G00 X0 Y-0.634 B0
M07
G01 X4.330 Y0      B0 F500
G01 X4.454 Y4      B0 F1000
G01 X4.822 Y8      B0 F1000
G01 X5.428 Y12     B0 F1000
M08
M02
```

15.10 Practical notes

- Set the chuck pulse number by turning the chuck through a known angle, measuring the real angle and correcting the value in the same way as the linear pulse numbers (section 13.2).
- Support long pipe on rollers close to the chuck. An unsupported overhang bends under its own weight and spoils the cut profile.
- Check that the pipe runs true before cutting begins. Run-out at the free end shows directly as an error in the cut.
- Keep the chuck speed low on large-diameter pipe; the surface speed at the cut, not the rotational speed, has to match the cutting speed.
- Confirm that the *Pipe mode* output really changes the enable between the trolley and the chuck before the first cut is made.

PART B

Plasma Torch Height Controller

Introduction • Installation • Functions • Panel and parameters • Interfaces • Fault finding

Chapter 16 Torch Height Controller – Introduction

16.1 What the height controller does

The Cruxweld DynaCut ProX torch height controller keeps the plasma cutting torch at a constant distance from the plate. It does this by measuring the plasma arc voltage, which changes with the stand-off because the plasma power source has a constant-current characteristic: as the torch rises, the arc lengthens and the arc voltage rises; as the torch falls, the arc voltage falls. The controller compares the measured voltage with the voltage that has been set and drives the lifter motor up or down to bring them together.

Constant stand-off is what makes a plasma cut square, clean and repeatable. It also protects the consumables: a torch that is too low picks up spatter and a torch that is too high cuts with a wide, bevelled kerf and a heavy dross edge.

The height controller suits the great majority of plasma cutting machines, whether the plasma source is imported or made locally.

16.2 Technical data

No.	Item	Data
1	Working voltage	DC 24 V $\pm$ 10 %
2	Motor	DC 24 V motor
3	Drive mode	Pulse width modulation (PWM)
4	Output current	1 A – 4 A (maximum power 50 W)
5	Working temperature	–10 °C to +60 °C
6	Initial positioning	Shield positioning and proximity switch positioning
7	Operation transmission	Arc-voltage detection enabled, pierce output
8	Voltage division ratio	50 : 1
9	Control precision	Set arc voltage against actual arc voltage $\pm$ 1 V to $\pm$ 2 V
10	Outline dimensions	271 × 171 × 70 mm
11	Torch lifting speed	800 – 4 000 mm/min (2 500 mm/min recommended)
12	Set arc voltage range	50 V – 250 V
13	Overload protection	PWM with over-current protection
14	Maximum tracking test speed	24 000 mm/min

16.3 How the two units work together

The DynaCut ProX cutting controller can be supplied with the arc torch-height module built in, in which case the arc voltage is measured and the lifter is driven from the controller itself through CN4 and CN5 (see Chapter 11). On larger machines, or where the lifter motor needs more power, the separate DynaCut ProX torch height controller described in this part is used instead. It carries its own display, its own knobs and its own motor driver, and exchanges only simple signals with the cutting controller:

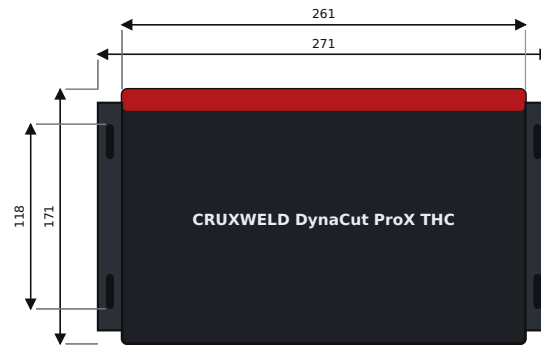
- the cutting controller commands the arc start and the automatic height control;
- the height controller reports that the pierce is complete and that the arc has been struck, so that the cutting controller may begin to move;
- the height controller reports a collision at once, so that the cutting controller can stop before the torch is damaged.

Section 11.2.3 describes how the cutting controller is set up to work with a separate height controller.

Chapter 17 Installing the Height Controller

17.1 Installation dimensions

Figure 17.1 DynaCut ProX torch height controller - installation size



Depth 70 mm. Fixing slots 6 x 26 mm in both mounting ears.

Overall size 271 x 171 x 70 mm

17.2 Mounting and wiring rules

1. Mount the height controller where the operator can see the two displays from the working position, and where the cutting fume cannot reach it.
2. Bond the PE terminal to the machine earth with a short, heavy conductor. Good earthing is the single most effective measure against the high-frequency interference of the plasma source.
3. Run the arc-voltage cable in screened cable, separately from the plasma power leads and from the work return. Bond the screen at the height controller end only.
4. Take the arc voltage from the divider board, never directly from the electrode and the workpiece.
5. Watch the polarity of the arc-voltage signal. If the two leads are reversed the display shows **E3** and automatic control is disabled.
6. Run the motor cable and the proximity-switch cable in separate ducts from the arc-voltage cable.
7. Use a 24 V supply of at least 2 A for the height controller and its motor.

WARNING

- Switch off and isolate the plasma source before any wiring is touched. The open-circuit voltage of a plasma source is lethal.
- The high-frequency start pulse of a plasma source will damage electronics that are wired directly to it. Always use the divider board for the arc voltage and an isolating relay for the arc-start contact.
- Check the whole installation before the first arc is struck, with the torch clear of the plate and the machine free to move.

17.3 First setting-up

1. With the plasma source switched off, check that the lifter runs up and down from the **[▲]** and **[▼]** keys, and that the upper and lower limits stop it. If the motor runs the wrong way, exchange the two motor leads.
2. Press **[IHS]** and watch one positioning cycle. The torch should descend, touch the plate, stop and rise to the positioning height.
3. Set the positioning height with the **IHS HEIGHT** knob so that the tip stands at the ignition height recommended for the consumables in use.
4. Set the arc voltage with the **ARC VOLTAGE** knob to the value given in the cutting chart of the plasma source for the plate thickness and the cutting speed.
5. Set the pierce delay with the **PIERCING DELAY** knob; 5 to 30 (0.05 s to 0.3 s) covers most work.
6. Make a test cut, then trim the arc voltage: a higher setting raises the torch and a lower setting lowers it.

Chapter 18 Height Controller Functions

18.1 Automatic initial positioning

Initial positioning can be done either by a proximity switch or by shield collision detection. The two methods may be used alone or together.

Proximity switch positioning

The height controller is supplied with an NPN normally open proximity switch, which is in contact under normal conditions. During a positioning test, or during the initial positioning before the arc is struck, the torch descends. When the torch touches the workpiece – or when it tilts because it has touched the workpiece – the proximity switch releases, the detection circuit sees the signal, and the torch rises to the initial positioning height. That height is set with the **IHS HEIGHT** knob on the panel. While the proximity switch stays released, the torch keeps rising until it reaches the upper limit of the motor.

Shield collision detection (option; state it with the order)

With shield collision detection, the detection circuit acts as soon as the torch shield touches the workpiece in any state, and the torch rises to the initial positioning height. Under normal conditions the collision signal resets as soon as the torch rises and the shield leaves the workpiece. If the collision signal is held, the torch keeps rising until it reaches the upper limit of the motor.

The proximity switch may be normally open or normally closed; the factory setting is normally open. The setting is made with parameter **P9**. If it is set wrongly the controller reports the **E5** collision alarm.

18.2 Automatic arc voltage control

Provided the actual arc voltage does not exceed the set value by more than 30 V, and the conditions for automatic height control are met, the height controller works in automatic mode.

18.3 Display and monitoring of the arc voltage

Two rows of high-brightness numeric displays show the arc voltage. The upper row shows the set arc voltage and the lower row shows the actual arc voltage, so the operator can watch the arc voltage in real time while cutting.

18.4 Manual operation

Automatic and manual height control, manual raise, manual lower, arc-start test, initial positioning test and the menu are all reached from the operation panel.

18.5 Automatic operation

When the cutting controller issues the arc-start signal, the height controller carries out the whole sequence by itself: initial positioning, arc start, and the successful-arc-start feedback. As soon as the cutting controller receives that feedback it moves the machine and cuts.

18.6 Knob operation

Three knobs on the panel set the arc voltage, the initial positioning height and the pierce delay.

18.7 Automatic torch lift at the end of a cut

When the cutting controller switches off the cutting signal, the height controller lifts the torch for the time set by parameter **P8**, so that the torch is protected while the machine travels between cuts.

18.8 Automatic torch lift on collision

If a collision occurs outside cutting and outside positioning, the torch is lifted at once. If a collision occurs during the positioning test or during cutting, the torch is lifted for the initial positioning height time.

18.9 Dynamic piercing

Where a pierce delay is used during cutting, the torch can be raised by one step at the moment the arc is struck and lowered again to the original height when the pierce delay has elapsed. Lifting the torch during the pierce keeps the molten slag from spattering onto the torch. If the dynamic pierce lift time is set to zero the torch is not lifted at the moment of arc start. The dynamic pierce height is set with parameter **P4**.

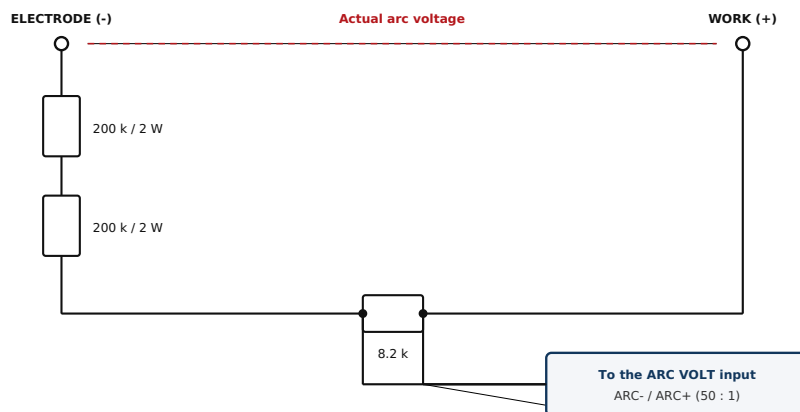
18.10 Collision signal feedback

The height controller reports a collision to the cutting controller immediately, so that the cutting machine stops before the torch is damaged.

18.11 Collecting the arc voltage signal

Arc voltage control depends on detecting the change of the plasma arc voltage. The plasma arc voltage is the voltage between the electrode and the workpiece. The positive pole of the plasma source is connected to the workpiece and the negative pole to the cutting torch. The voltage is divided down before it is measured.

Figure 18.1 Arc-voltage division principle



Observe the polarity. If the two leads are reversed the display shows E3 and automatic control is disabled.
Because of the severe high-frequency interference during arc striking, never take the arc-voltage signal directly from the workpiece and the electrode; always take it from the divider board.

IMPORTANT

1. Watch the polarity of the divided arc-voltage signal. If the leads are reversed the display shows **E3** straight away and automatic control is disabled.
2. There is severe high-frequency interference while the arc is being struck, so the arc-voltage circuit must never be connected directly to the workpiece and the electrode. Always take the signal from the divider board.

18.12 Getting a good cut

Symptom	Usual cause and remedy
Bevelled kerf, wide at the top	Stand-off too large. Lower the set arc voltage a little.
Heavy dross on the underside	Cutting speed or stand-off wrong for the plate. Check the cutting chart of the plasma source, then trim the arc voltage.
Nozzle picks up spatter	Stand-off too small, or the dynamic pierce height is set to zero. Raise the arc voltage slightly and set a dynamic pierce height with P4.
Torch hunts up and down	Sensitivity too high. Reduce parameter P10.
Torch follows the plate too slowly	Sensitivity too low. Raise parameter P10.
Torch dives at a lead-out or at the edge of the plate	The arc voltage rises suddenly when the arc leaves the plate. Set the over-arc-voltage protection P13 so that the controller stops and lifts instead of diving.

Chapter 19 Height Controller Panel and Parameters

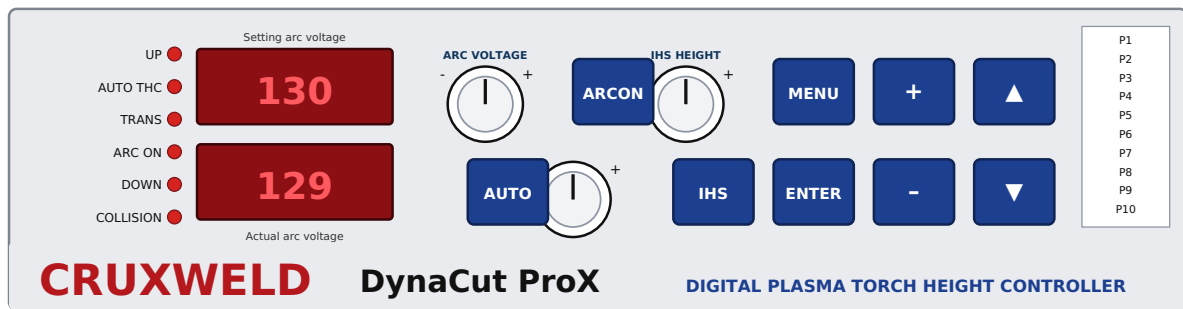


Figure 19.1 Torch height controller operation panel

19.1 Displays

Two three-digit displays show the set arc voltage, the actual arc voltage, the parameters and the various states of the controller.

19.2 Knobs

Knob	Range	Function
ARC VOLTAGE	50 – 250 V	Sets the arc voltage from the thickness and the speed of the material and the chart supplied with the plasma source. Before the arc is struck the display shows the pre-set voltage; during normal cutting it shows the actual voltage. The setting fixes the stand-off between the torch and the workpiece: the higher the set arc voltage, the greater the cutting height.
IHS HEIGHT	0 – 199	Turn clockwise to raise the positioning height, counter-clockwise to lower it. One unit is 10 ms, so the range is 0 to 1.99 s. One second after the knob is released the display returns to the main menu.
PIERCING DELAY	0 – 60	Sets the time from the plasma arc start to the moment the cutting machine begins to move. Turn clockwise for a longer delay, counter-clockwise for a shorter one. One unit is 10 ms, so the range is 0 to 6 s; 5 to 30 covers most work. One second after the knob is released the display returns to the main menu.

19.3 Keys

Key	Function
[IHS]	Runs one initial positioning test, so that the positioning height can be checked. Pressing the key again, or pressing [▲] before the torch has reached the workpiece, cancels the test.
[ARCON]	Direct arc-start test. The arc is shut down automatically three seconds after it has been struck and the torch is lifted to the height set by P08.
[AUTO]	Switches the automatic height control off and on. Automatic control is allowed by default after switching on and the AUTO indicator is lit. Press the key once to disable it; the indicator goes out.
[MENU]	Enters and leaves the menu.
[▲]	Raises the cutting torch.
[▼]	Lowers the cutting torch.
[ENTER]	In the menu, the first press opens the parameter for editing and the second press confirms the new value.
[+]	Steps up through the parameter numbers, or raises the parameter value while it is being edited.
[–]	Steps down through the parameter numbers, or lowers the parameter value while it is being edited.

19.4 Indicators

Indicator	Meaning
UP	Lit while the cutting torch is rising.
DOWN	Lit while the cutting torch is descending.
AUTO THC	Off: the controller is in manual. Flashing: automatic height control is allowed. Lit: automatic height control is working.
TRANS	Lit when a valid arc voltage has been detected and the pierce is complete. This refers to the pierce delay of the height controller, not to that of the cutting controller.
ARC ON	Lit when the arc-start command has been given. With the “arc start with initial positioning” signal, it lights as the arc-start command is issued at the end of the positioning. It stays lit throughout the arc-start test and throughout height control.
COLLISION	Lit when the shield touches the workpiece, when the proximity switch releases, or when the logic of the proximity switch is set wrongly.
AUTO (above the key)	Lit: automatic height control is allowed. Off: it is prohibited. It is lit by default at switch-on and changes state each time the key is pressed.
IHS (above the key)	Lit during the initial positioning test and off at all other times.

Three conditions must be met before the automatic indicator lights: automatic height control must be allowed (the AUTO indicator is flashing); the automatic signal from the cutting controller must be active; and the height controller must be detecting an arc voltage signal.

19.5 Restoring the factory settings

Press **[+]** and **[-]** together, then press **[ENTER]**. The factory default parameters are restored and the UP, DOWN and IHS indicators light.

19.6 Using the menu

The menu is operated with four keys: **[MENU]**, **[ENTER]**, **[+]** and **[-]**. The upper row of the display shows the parameter number and the lower row shows its value.

1. Press **[MENU]**. The upper row shows **P01** and the lower row shows its value, 130 by default.
2. Press **[ENTER]**. The value flashes.
3. Press **[+]** or **[-]** to change the value.
4. Press **[ENTER]** again to store it.
5. Press **[MENU]** to leave the menu.

The menu can be entered only when the controller is not cutting and no arc-start test or positioning test is running. Parameters P01 to P09 are reached by pressing the menu key; P10 to P16 are reached by holding the menu key for two seconds. Inside the menu the positioning test, arc-start test, automatic / manual and the two torch keys are disabled; only **[ENTER]**, **[+]**, **[-]** and the THC_UP and THC_DN signals from the cutting controller are active. Neither a test nor a cut can be performed while the menu is open.

The arc voltage P01 can be set either with the knob on the panel or through the menu. Whichever is used, the other follows.

19.7 General parameters

No.	Description	Default	Unit	Range	Meaning
P01	Arc setting	130	V	50 – 250	Active in arc-voltage height control. Gives the arc voltage before cutting. It can be changed in real time with the arc-voltage knob on the panel.
P02	Piercing time	1	0.1 s	0 – 60	Time from the plasma arc start to the moment the cutting machine begins to move. Set it from the plate thickness; the pierce time rises with the thickness.
P03	IHS height	30	0.01 s	0 – 199	Arc-start height of the torch, set from the plasma cutting parameters and the plate thickness. Find it with a positioning test on the panel; its value depends on the lifter. It is also the working position for the dynamic pierce.

19.8 Special parameters

No.	Description	Default	Unit	Range	Meaning
P04	Dynamic pierce height	0	0.01 s	1 – 99	Raises the torch at the moment the plasma arc is struck for the pierce, which protects the nozzle from damage.
P05	Arc sampling logic	0	-	0 / 1	0: the arc voltage set by P01 is used as the given arc voltage for automatic height control. 1: the actual arc voltage at the moment the corner signal from the cutting controller enables the height control is taken as the set arc voltage. See the note below.
P06	Limit logic	0	-	0 / 1	0: normally open. 1: normally closed.
P07	Corner signal logic	0	-	0 / 1	0: automatic corner pull-in. 1: automatic corner opening.
P08	Up after arc off	5	0.2 s	0 – 25	Height to which the torch is lifted when the cut ends. Setting range 0 to 5 s.

No.	Description	Default	Unit	Range	Meaning
P09	Switch IHS logic	0	-	0 / 1	0: active low. 1: active high. This is the logic of the proximity switch; if it is set wrongly the controller reports the E5 collision alarm.
P10	Sensitivity setting	3	-	1 - 5	Sets how sharply the controller responds to a change of arc voltage. The best value depends on the lifter.
P11	Quick braking	50	-	0 - 100	Adjusted before delivery; it does not normally need to be changed.
P12	Balance point	50	-	0 - 100	Balance point of the drive.
P13	Over-arc-voltage protection	30	V	20 - 50	Protects the torch against a sudden dive caused by a sudden rise of arc voltage. While plasma cutting, the arc voltage rises instantly if the torch passes a joint - a lead-in or a lead-out - or cuts off the edge of the plate, and the torch would drop rapidly. When the rise exceeds the value set here the controller reports the E4 alarm, shuts down and lifts the torch to the P08 height.
P14	Plasma / argon arc welding	0	-	0 / 1	0: plasma torch height control. 1: argon arc welding height control (customised function).

Note on P05 = 1. In this mode the machine needs a high acceleration. When the travel speed reaches the set speed the automatic height control is switched on and the torch works at the height set for the initial positioning, which makes the mode suitable for bevel cutting. The set arc voltage can still be changed in real time with the panel knob while cutting. The cutting height stays unchanged throughout one cutting cycle until the arc-start signal is removed.

19.9 Alarm codes

Code	Alarm	Cause	Remedy
E1	Communication error	The communication cable between the operation panel and the height-control host is not connected, or is wired wrongly.	Reconnect the cable and look for a poor contact; check that the wiring is correct; the circuit board may be faulty.
E2	Corner signal error	The connection and the setting of the corner signal are checked automatically. If they do not agree, E2 is reported at the moment of arc start or initial positioning.	Change the automatic corner signal logic of the cutting controller, or change parameter P07; look for an open circuit in the line to the cutting controller, or a damaged I/O port on the cutting controller; the main board of the height controller may be faulty.
E3	Arc detect failure	No arc voltage signal is detected while cutting.	Check the polarity of the arc-voltage leads and look for an open circuit; the divider board or the main board may be faulty; the arc-detection time of the cutting controller may be too short; the pierce time may be too long; the plasma source may be faulty.
E4	Over arc voltage	The actual arc voltage exceeds the set arc voltage by more than the P13 value (default 30 V) during cutting.	The set arc voltage may be too low; the dynamic pierce height may be too large; the automatic height-control signal from the cutting controller may be switched on too early; the plasma source or the torch may be faulty; the circuit board may be faulty.

Code	Alarm	Cause	Remedy
E5	Collision alarm	Before and during cutting, a signal from the proximity switch means that a collision has occurred. An ordinary collision simply lifts the torch. If the signal lasts more than one second, E5 is reported and a collision alarm is sent to the cutting controller.	If the collision repeats because the micro-switch positioning signal is being triggered, check the micro-switch and its circuit. If the supply lead of the proximity switch is broken, a single continuous E5 alarm is produced. If the proximity switch itself has failed, replace it. E5 can be cleared only with the [ENTER] key, and a flashing E5 cannot be cleared until the cause has been removed. The circuit board may be faulty.
E6	Motor over-current	The motor does not run.	E6 can be cleared only with the [ENTER] key. Look for a short circuit in the motor; the main board may be faulty.
UP / DOWN flashing	Upper and lower limit alarm	The torch has run to the upper or the lower limit while the height controller was working. The UP or the DOWN indicator flashes and the machine stops.	If the table and the workpiece lie outside the effective stroke of the torch, adjust the height so that the lifter works within its stroke while cutting; this also protects the cut quality. Check the P06 limit logic.

19.10 Quick reference

To do this	Press
Run one positioning test	[IHS]
Cancel a positioning test	[IHS] again, or [▲]
Test the arc start	[ARCON]
Switch automatic height control off or on	[AUTO]
Raise or lower the torch by hand	[▲] / [▼]
Open the menu	[MENU] (hold 2 s for P10 – P16)
Edit a parameter	[ENTER] , [+] / [-] , [ENTER]
Clear an E5 or E6 alarm	[ENTER]
Restore the factory settings	[+] and [-] together, then [ENTER]

Chapter 20 Height Controller Interfaces

The interfaces are on the rear of the height controller: the power input, the proximity switch and shield collision detection interfaces, the plasma device interface, the CNC interface and the motor drive interface.

Figure 20.1 Torch height controller interfaces (rear view)



20.1 CNC interface

This interface is connected to the CNC interface of the cutting controller. It is a ten-way terminal block.

Pin	Signal	Wiring description
1.1	AUTO – automatic	Automatic height control enable signal. Active low by default; the control logic can be changed.
1.2	UP – rise	Up control signal, active low.
1.3	DOWN – decline	Down control signal, active low.
1.4	IHS-ARCON – arc start with initial positioning	Initial positioning and arc start control signal, active low.
1.5	DIR-ARCON – direct arc start	Direct arc start signal, active low.
1.6	TRANSFER1 – pierce complete	Pierce-complete output. When a valid arc voltage is detected after the arc start and the pierce delay, the TRANSFER1 and TRANSFER2 contacts close. This is the normally open contact of a relay and is the successful-arc-start feedback to the cutting controller.
1.7	TRANSFER2 – pierce complete	
1.8	COM – control signal common	Common return for pins 1.1, 1.2, 1.3, 1.4, 1.5 and 1.9. Connect it to the signal ground of the cutting controller.
1.9	COLLISION – collision feedback	Open-collector output of the collision signal, up to 50 mA.
PE	Earth	Protective earth and cable screen.

20.2 Motor, limit and power interface

This interface goes to the lifting carriage and to the supply. It is a seven-way terminal block.

Pin	Signal	Wiring description
2.1	UP-LT – upper limit input	Upper limit of the lifter. Normally closed switch by default.
2.2	DOWN-LT – lower limit input	Lower limit of the lifter. Normally closed switch by default.
2.3	COM – limit common	Common return of the limit switches.
2.4	MOTOR1	24 V DC motor drive output, up to 50 W.
2.5	MOTOR2	If the motor runs the opposite way to the panel keys, exchange the two motor leads.
2.6	+24 V – supply positive	24 V DC supply.
2.7	24 VCOM – supply negative	24 V DC return.

20.3 Proximity switch and arc-start interface

This interface takes the proximity switch and the arc-start contact of the plasma source.

Pin	Signal	Wiring description
3.1	+15 V - supply	To the positive lead of the proximity switch (brown).
3.2	SIGNAL	Switching signal output of the proximity switch (black).
3.3	COM - common	To the negative lead of the proximity switch (blue).
3.4	ARCSTART1	Normally open contact of a relay. When the arc-start command is given, this contact closes and starts the plasma source.
3.5	ARCSTART2	

The proximity switch must be an NPN type. Two switches may be wired in series for a more accurate and more stable positioning; see section 11.4.6.

20.4 Arc voltage and shield interface

This interface takes the arc voltage from the divider board and, where fitted, the shield collision detection lead.

Terminal	Wiring description
ARC VOLT	Arc voltage from the plasma power source, through the divider board.
SHIELD	Shield collision detection line.
GND	Signal ground.
ELECTRODE	To the negative pole of the plasma source arc voltage.
WORK	To the positive pole of the plasma source arc voltage.
SHIELD (divider)	To the shield collision detection lead.

20.5 Signal exchange with the cutting controller

The table below shows how the two units are normally connected. Use it together with section 11.2.3, which describes the settings that must be made in the cutting controller.

Cutting controller	CN2 pin	Height controller
Plasma arc start	16	1.4 IHS-ARCON (arc start with initial positioning)
Lock THC (corner signal)	18	1.1 AUTO
Torch up	2	1.2 UP
Torch down	15	1.3 DOWN
24 VG	13	1.8 COM

Height controller		Cutting controller CN1
1.6 / 1.7 TRANSFER1 / TRANSFER2		Pin 4 Arc-on feedback, with the return to 24 VG
1.9 COLLISION		Pin 6 Plasma collision

Set the *Position detect* input of the cutting controller to **NC** when the height controller performs the positioning, and set *Arcing check time* long enough to cover both the positioning and the arc start.

IMPORTANT

Fit an isolating relay between the arc-start contact of the height controller and the plasma source. The high-frequency start pulse of a plasma source will otherwise find its way into both controllers.

Chapter 21 Height Controller Fault Finding

No.	Fault	Cause	Remedy
1	The displays and the indicators do not work	No 5 V supply; the regulator has failed	Check the switched-mode supply and the 5 V regulator
2	The motor does not run, or runs in one direction only	The field-effect drive devices are damaged; the +15 V drive supply has failed; over-current protection has operated; the motor is damaged	Replace the damaged drive devices; check the switched-mode supply; check the four field-effect devices and the associated resistors; replace the motor
3	The cutting torch keeps rising	The positioning switch is not mounted properly or is damaged; the polarity of the arc-voltage leads is reversed and E3 is reported	Check the positioning switch; correct the polarity of the arc-voltage leads
4	Automatic arc start fails	The positioning switch is damaged; the initial positioning height time is too short	Replace the positioning switch; lengthen the positioning time
5	Unstable arc voltage control	The sensitivity is too high; the plasma source is faulty	Check that the earthing is correct; reduce parameter P10; check the plasma source
6	The machine starts to move before the pierce is finished	The dynamic pierce height time is too short	Lengthen the pierce time
7	The arc is struck before the initial positioning is finished	The delay in the cutting controller is too short	Lengthen the time in the cutting controller, or repair the circuit board
8	The torch fails to strike an arc	-	Check that the cutting torch and the plasma source are in order
9	The plasma arc cannot be transferred to the workpiece	-	Check that the work return cable and the cutting torch are in order
10	The torch moves before the pierce is finished	Pierce time too short; consumables worn	Lengthen the pierce time; check the wearing parts of the torch
11	The torch drops as soon as the machine moves	The given arc voltage is too low; the corner signal or the automatic signal from the cutting controller is wrong	Raise the given arc voltage; check the corner signal and the automatic signal of the cutting controller
12	The plasma arc goes out immediately after transfer and pierce	The set delay is too long; this happens most often on thin plate	Shorten the pierce delay

No.	Fault	Cause	Remedy
13	The torch fails to lift after touching the workpiece during positioning	The set positioning time is too short; the circuit board is faulty	Lengthen the positioning time; have the board examined
14	The torch keeps pressing down after touching the plate	The proximity switch is damaged; the sampling signal of the height controller is open circuit or has a poor contact	Replace the proximity switch; check the sampling signal wiring
15	The torch oscillates in automatic mode	The sensitivity is set too high; the circuit board is faulty	Reduce parameter P10; have the board examined
16	Tracking is too slow in automatic mode	The sensitivity is set too low	Raise parameter P10
17	The arc is interrupted while cutting	The arc-voltage signal is not taken from the right place	Use the arc-voltage signal from the divider board of the cutting device
18	Automatic height control fails	The corner or automatic line to the cutting controller is open circuit or has a poor contact; the automatic function is not selected	Check the wiring; check that the automatic function is selected
19	The cutting controller does not run and reports an arc interruption	The successful-arc-start feedback circuit is open; the main board is faulty	Check the TRANSFER1 / TRANSFER2 circuit; have the board examined

21.1 A logical order of checks

Most faults on a plasma height control system are found quickly if the checks are made in this order.

1. **Earthing first.** A poor earth causes more strange behaviour than any other single fault. Check that the machine, the height controller and the plasma source all share a solid earth.
2. **Then the arc voltage.** Strike an arc with the height control in manual and watch the lower display. It must show a steady voltage close to the value in the cutting chart. A reading of zero or E3 means that the signal is not arriving; a wildly unsteady reading means interference.
3. **Then the positioning.** Press [IHS] and watch one cycle with the plasma switched off. The COLLISION indicator must light exactly when the torch touches the plate.
4. **Then the motor.** Drive the lifter up and down with the panel keys and check that the limits stop it.
5. **Then the signals from the cutting controller.** Use the output diagnosis of the cutting controller (section 8.2) to operate the arc-start and the automatic signals one at a time and watch the indicators of the height controller.
6. **Only then the parameters.** Sensitivity, positioning height and pierce delay are trimmed last, once everything else is proved.

21.2 Routine maintenance

Interval	Work
Every shift	Check the torch consumables. Worn consumables change the arc voltage and make the height control appear faulty.
Weekly	Clean the proximity switch and the torch shield; check that the lifter slides freely over its whole stroke.
Monthly	Check every earth bond, check the arc-voltage cable and its screen, and check that the cable glands are tight.
Every six months	Check the limit switches, the motor brushes where fitted, and the tightness of every terminal.

APPENDICES

Reference

Code reference • I/O timing charts • External height controllers • Installation sizes • Fault finding

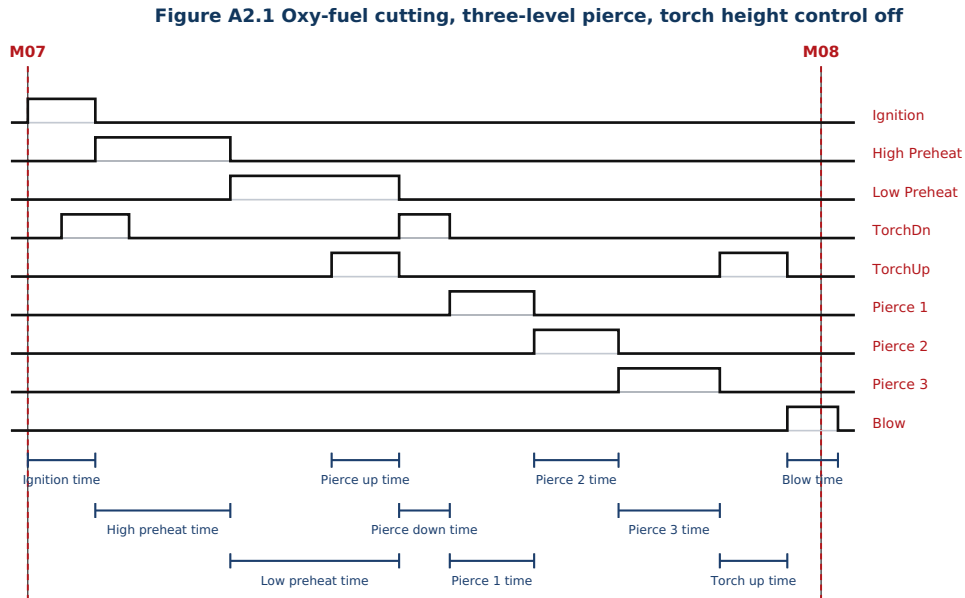
Appendix 1 G and M Code Quick Reference

No.	Code	Function
1	G99	Scale, rotate and mirror
2	G92	Reference coordinate
3	G91	Relative coordinate system
4	G90	Absolute coordinate system
5	G20	Inch units
6	G21	Metric units
7	G26	Rapid return of the X axis to the reference point
8	G27	Rapid return of the Y axis to the reference point
9	G28	Rapid return of both axes to the reference point
10	G41	Left kerf compensation
11	G42	Right kerf compensation
12	G40	Cancel kerf compensation
13	G00	Rapid traverse
14	G01	Linear cutting
15	G02	Clockwise circular cutting
16	G03	Counter-clockwise circular cutting
17	G04	Program delay
18	M07	Start the cutting cycle
19	M08	Stop the cutting cycle
20	M11	Marker offset on
21	M12	Marker offset off
22	M09	Powder on
23	M10	Powder off
24	M00	Pause
25	M02 / M30	End of program

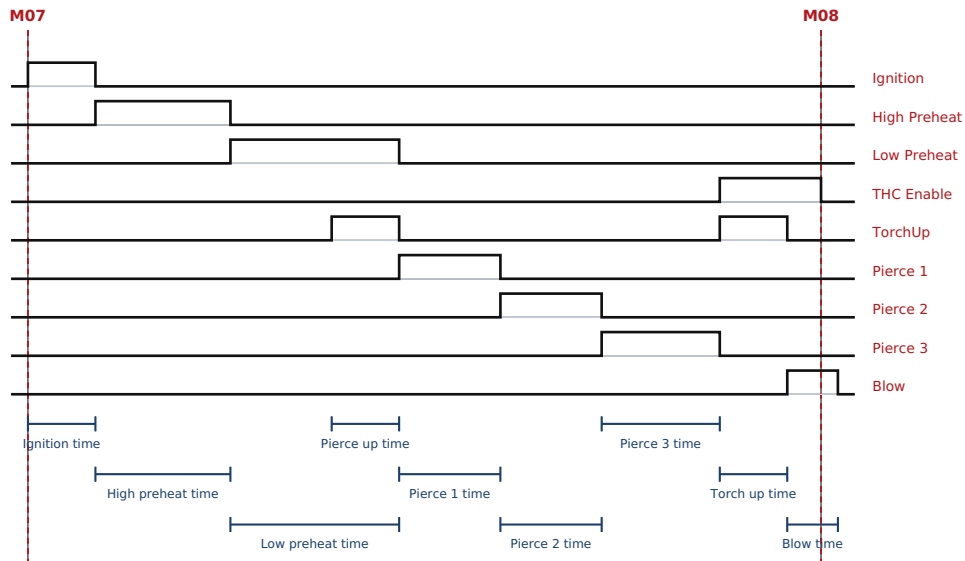
Every program must contain G92 and M02. G41 or G42 must always be paired with G40. M07 and M08 may not be omitted.

Appendix 2 I/O Timing Charts

In the charts below, the names on the right are the output ports of the controller and the labels under the waveforms are the parameters that set each interval.



The cutting motion starts at the end of the Pierce 3 time and stops when M08 is executed.

Figure A2.2 Oxy-fuel cutting, three-level pierce, torch height control on

With torch height control enabled the torch-down output is replaced by the THC-enable output; the height controller then holds the stand-off automatically.

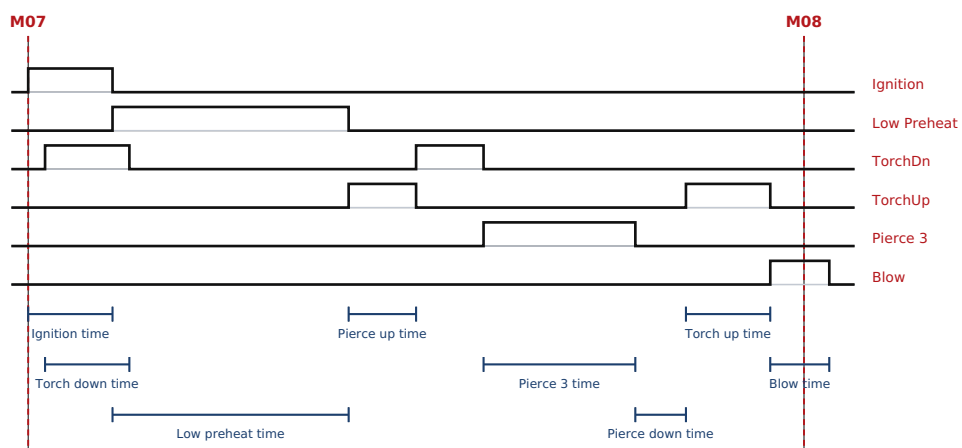
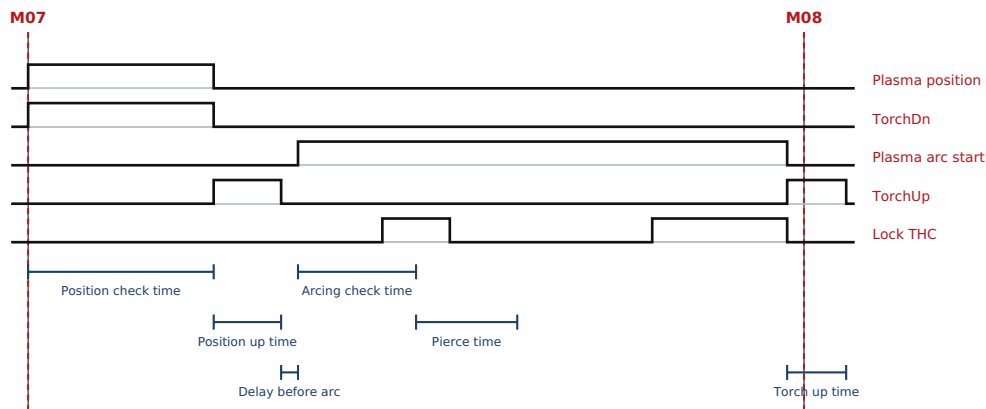
Figure A2.3 Oxy-fuel cutting, single-level pierce, torch height control off

Figure A2.4 Plasma cutting I/O timing sequence



The positioning phase ends early as soon as the position-detect input becomes active; if it never becomes active within the Position check time the controller raises an alarm. The arcing check time ends early as soon as the arc-on feedback arrives.

Lock THC is switched on whenever the present rate falls to or below $(\text{Speed to lock THC} \times \text{cutting speed}) / 100$, or whenever the distance to the start or end point of the current code line is smaller than the Distance to lock THC.

Reading the plasma chart

- The positioning phase ends as soon as the position-detect input becomes active; it does not have to run for the whole Position check time.
- The arcing check phase ends as soon as the arc-on feedback arrives. If the feedback has not arrived when the Arcing check time has elapsed, the controller raises an alarm and stops.
- Lock THC is switched on whenever the present rate falls to or below $(\text{Speed to lock THC} \times \text{cutting speed}) / 100$, and whenever the distance to the start or to the end point of the present code line is smaller than the Distance to lock THC. Both conditions are evaluated continuously while cutting.
- Whether Lock THC is active high or active low is set by the type of the output in the output definition screen (section 8.6.3); the two variants are otherwise identical.

Appendix 3 Working with an External Height Controller

The DynaCut ProX drives its own torch height controller directly. Where an arc-voltage height controller of another make is already fitted to the machine, the controller can drive that instead. Almost every such unit falls into one of two classes, and the wiring and the parameter settings differ between them.

A3.1 Class 1 - the height controller performs the positioning

The height controller carries out the initial positioning itself, strikes the arc and returns the arc-on feedback. The cutting controller only has to command the arc start and wait.

DynaCut ProX output	CN2 pin	External height controller
Plasma arc start	16	Arc start with initial positioning
Lock THC (corner signal)	18	Automatic / external automatic input
Torch up	2	Up input
Torch down	15	Down input
24 VG	13	Common

External height controller	CN1 pin	DynaCut ProX input
Arc-transfer contacts (pierce complete)	4	Arc-on feedback, with the return to 24 VG
Collision feedback	6	Plasma collision

Settings

Plasma parameter	Range	Recommended
Delay before arc	0	0
Pierce time	0	0
Torch up time	0 - 3 s	3
Arcing check time	5 - 30 s	30
Position check time	0	0
Speed to lock THC	90 - 100 %	95
Distance to lock THC	0 - 15 mm	10
Lose arc delay	0 - 1 s	0.5
Watch arc enable	Yes / No	Yes

Set the parameters with **[F4]** (Setups) → **[F3]** (Plasma). Set the port types with **[F5]** (Diagnose) → **[F8]** (System definition) → **[F3]** (Definition), password **1396**:

Port	Number	Type
Position detect (input)	05	NC
Lock THC (output)	18	NO

Because the height controller does the positioning, the positioning function of the cutting controller must be switched off. That is what setting *Position detect* to **NC** does.

A3.2 Class 2 - positioning by lowering the torch first

The cutting controller issues the torch-down command, waits for the torch to reach the plate and only then issues the arc-start command. The height controller simply follows the up and down commands.

DynaCut ProX output	CN2 pin	External height controller
Plasma arc start	16	Arc start
Lock THC (corner signal)	18	Automatic input
Torch up	2	Up input
Torch down	15	Down input
24 VG	13	Common (both ground pins where two are provided)

Settings

Plasma parameter	Range	Recommended
Delay before arc	0	0
Pierce time	0 – 3 s	from the plate thickness
Torch up time	0 – 3 s	3
Arcing check time	0	0
Position check time	3 – 30 s	15
Speed to lock THC	90 – 100 %	95
Distance to lock THC	0 – 15 mm	10
Lose arc delay	0 – 1 s	0.5
Watch arc enable	Yes / No	No

Port	Number	Type
Position detect (input)	05	NC
Lock THC (output)	18	NC

Set *Position check time* to the time the torch really needs to travel down to the plate. Too short a time causes the arc to be struck before the torch has arrived.

A3.3 Positioning performed by the cutting controller

Where the machine has its own positioning switch and the cutting controller is to do the positioning:

1. Set the type of the *Position detect* input (05) to **NO**.
2. Wire the positioning-success signal back to pin 5 of CN1.
3. Set *Position check time* and *Position up time* in the plasma parameters to suit the lifter.

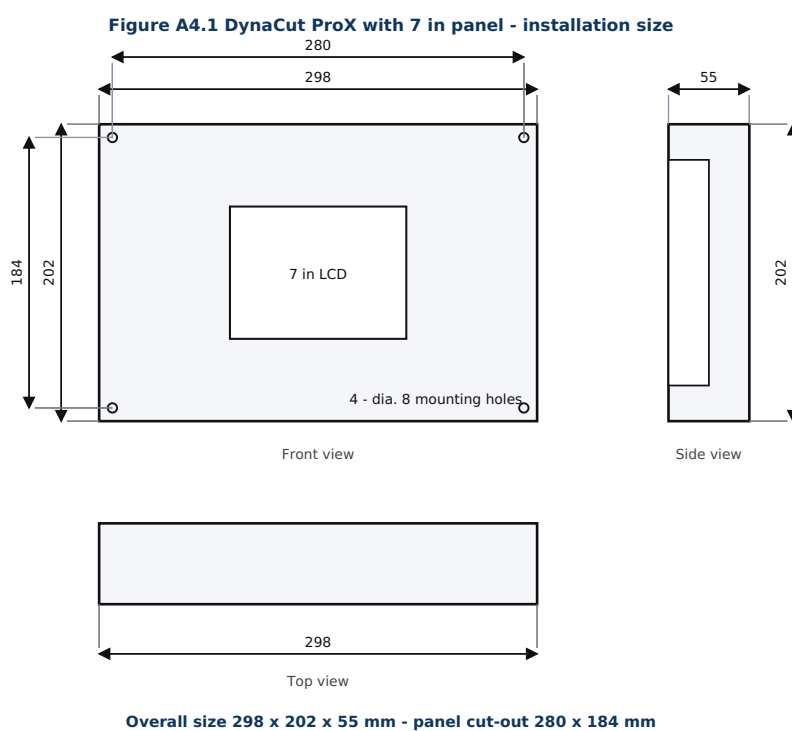
A3.4 Choosing the corner-signal logic

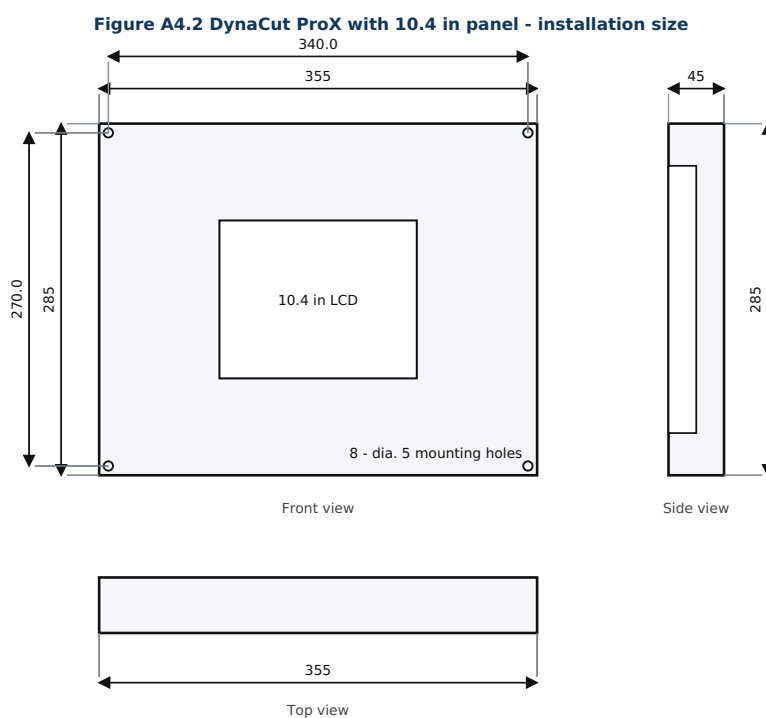
The height controller takes	Lock THC type	Behaviour
A corner-low-speed input	NO	The controller outputs a low level while the rate is being reduced and releases the signal during normal cutting.
An auto / manual input	NC	The controller releases the signal while the rate is being reduced and outputs a low level during normal cutting.

BEFORE THE FIRST CUT

Prove every signal with the output diagnosis of the cutting controller (section 8.2) and the input diagnosis (section 8.1), with the plasma source switched off, before the first arc is struck. It is far cheaper to find a reversed signal on the bench than on the plate.

Appendix 4 Installation Sizes





Overall size 355 x 285 x 45 mm - panel cut-out 340 x 270 mm

A4.1 Summary of sizes

Unit	Overall size (mm)	Mounting
DynaCut ProX, 7 in panel	298 x 202 x 55	4 holes 8 mm dia., 280 x 184 mm pitch
DynaCut ProX, 10.4 in panel	355 x 285 x 45	8 holes 5 mm dia., 340 x 270 mm pitch
DynaCut ProX torch height controller	271 x 171 x 70	4 slots 6 x 26 mm in the two mounting ears, 261 mm apart

Allow at least 50 mm of clear space behind each unit for the connectors and the cables, and leave the panel aperture 1 mm larger than the stated cut-out so that the unit slides in without strain.

Appendix 5 Fault Finding

A5.1 Motion faults

Symptom	Cause	Remedy
X or Y axis does not move	Wiring error; the motor driver stage has failed	Check the wiring; see A5.6
X or Y axis moves the wrong way	Wiring error; wrong parameter setting	Check the external wiring; reverse the motor direction in section 8.6.5
X or Y axis moves in one direction only	Wiring error; the servo parameters are wrong; the motor driver stage has failed	Check the wiring; confirm that the servo is set to pulse-plus-direction mode; see A5.6
X and Y are interchanged	Wiring error; wrong parameter setting	Check the wiring; set <i>XY exchange</i> to Yes in section 8.6.5
The motors run intermittently	Poor contact at the motor connector; a dry joint on the driver stage	Reseat the motor connector; return the controller for service
The cut shape is smaller than it should be	Pulse number too small; mechanical fault	Correct the pulses per millimetre (section 13.2); check the mechanics
The cut shape is larger than it should be	Pulse number too large; zero drift; mechanical fault	Correct the pulses per millimetre; earth the screens and fit a ferrite ring; check the mechanics
Inner and outer circles come out the wrong size	Kerf value too large or too small	Reset the kerf to half the real kerf width
Part sizes change suddenly	Mechanical fault; poor pulse matching between controller and driver	Check the gear, the rack and the reducer; fit a 4.7 k to 10 k resistor across PUL+ and PUL–
The machine moves on its own at switch-on	<i>Remote controller type</i> is set although no remote control is fitted	Set <i>Remote controller type</i> to NO (section 8.6.6)
Hard limit alarm although no limit has been reached	The NO / NC type of a limit input is reversed	Change the type of that input in section 8.6.2
Emergency-stop alarm although the button is not pressed	The NO / NC type of the emergency-stop input is reversed	Change the type of that input in section 8.6.2
The machine travels short	Pulse equivalent wrong; mechanical fault	Correct the pulses per millimetre; check the mechanics
The machine travels long	Pulse equivalent wrong; zero drift; mechanical fault	Correct the pulses per millimetre; fit a ferrite ring on the encoder cable; check the mechanics

A5.2 Input and output faults

Symptom	Cause	Remedy
No input responds	Wiring error; the common is wrong	The input common must be pin 13 or pin 25 of CN1, and the supply must be 24 V–
One input does not respond	Wiring error; that input has failed	Check the wiring; see A5.4
No output operates	The output common is wrong; the output driver has failed	Check the connection; return the controller for service
One output does not operate	That output has failed	See A5.5; redefine the port onto a spare pin if necessary
Lock THC does not operate at the corner	The NO / NC type of the Lock THC output is reversed; the speed and distance settings are wrong	Change the output type in section 8.6.3; set <i>Speed to lock THC</i> to 95 % and <i>Distance to lock THC</i> to 5 mm

A5.3 Plasma and height control faults

Symptom	Cause	Remedy
Nothing happens when plasma cutting is started	The positioning input is fed back wrongly; the arc-start output has failed; edge cutting is enabled; the arcing check time is set to 0	Check the positioning input (A5.4); check the arc-start output (A5.5); switch edge cutting off; set the arcing check time
A collision is reported but no collision has happened	Interference; the collision switch is faulty	Trace and suppress the source of interference; check the switch
Collision warning	The torch has struck the plate	Raise the torch position and check the positioning height
The arc goes out during the cut	The arc-on feedback is unstable; the consumables are worn	Lengthen <i>Lose arc delay</i> ; change the consumables

A5.4 Checking an input

1. Press **[F5]** (Diagnose) → **[F1]** (Input).
2. Short the input pin of CN1 to 0 V (CN1 pin 13).
3. If the indicator for that input changes, the input is sound.
4. If it does not change, the input has failed. Redefine the function onto a spare port (section 8.6.2) or return the controller for service.

A5.5 Checking an output

1. Press **[F5]** (Diagnose) → **[F2]** (Output).
2. Move the cursor to the output and press **[F3]** to switch it on.
3. Measure between that pin of CN2 and the common pin 12 or 24. DC 24 V must be present.
4. If there is no voltage the output stage has failed. Redefine the function onto a spare port (section 8.6.3) or return the controller for service.

A5.6 Checking the motor driver stage

Measure at the CN3 socket with the machine both running and stopped.

Axis	Pins	State	Correct voltage
X	1 and 9	Running	DC 3 – 3.5 V
	1 and 9	Stopped	DC 3 – 3.5 V
	2 and 10	Running	DC 0 V
	2 and 10	Stopped	DC 3 – 3.5 V
Y	3 and 11	Running	DC 3 – 3.5 V
	3 and 11	Stopped	DC 3 – 3.5 V
	4 and 12	Running	DC 0 V
	4 and 12	Stopped	DC 3 – 3.5 V

If any one of these readings is wrong, the motor driver stage has failed and the controller must be returned for service.

A5.7 File and software messages

Message or symptom	Cause	Remedy
The automatic screen freezes after start-up	A damaged file; a damaged parameter	Boot to the welcome screen and press [DEL] ; recover the parameters with [F5] → [F8] → [F1]
The controller freezes when the file manager is opened	The file system is damaged	Clear the code files with [F5] → [F8] → [F7] ; if that does not help, use the system recovery in the BIOS
A file cannot be opened	Wrong file format; old software version	Check that the extension is TXT, CNC, NC, B3 or MPG; update the software
"No file"	Wrong format; no file on the USB stick; the stick is formatted wrongly	Put a supported file in the root directory of the stick and format the stick as FAT or FAT32
"Cannot edit file"	There is no file on the internal disk	Copy at least one file from the USB stick to the internal disk
"Cutting speed error"	The speed in the common parameters is above the system speed limit	Raise <i>Max cutting speed</i> in the system parameters, or lower the cutting speed
"Manual shift speed error"	The manual speed is above the system limit	Raise <i>Max manual speed</i> in the system parameters
"Empty range shift speed error"	The rapid-traverse speed is above the system limit	Raise <i>Max G00 speed</i> in the system parameters
"Kerf error, clear the kerf"	The kerf is larger than the lead-in, or larger than the smallest arc radius in the shape	Lengthen the lead-in; reduce the kerf; remove the very small arcs from the shape
"Parameter import failed"	No parameter file on the USB stick; USB fault	Check that the parameter file is on the stick; try another stick
"Parameter export failed"	The stick is not seated; the stick is faulty	Reseat or replace the stick
"Please insert U disk" during an update	No stick inserted; USB fault	Insert the stick before starting the update; try another stick
"Upgrade file not found"	The upgrade file is missing, or is not in the root directory	Put the upgrade file in the root directory of the stick
"Upgrade fail"	The update did not complete	Restart the controller and repeat the update
"Error code 0"	The time-limit protection has expired	Contact Cruxweld for the decryption code

A5.8 Hardware faults

Symptom	Cause	Remedy
Blank screen after switching on	No supply; supply voltage too low; the 3 A fuse has blown; the main board does not start	Check the switched-mode supply; measure the DC 24 V; replace the fuse; return the controller for service
White, distorted or flashing screen	Display driver fault; display fault; loose cable	Reseat the display cable; return the controller for service
Keys do not respond	Wrong screen; the key has failed	Confirm the screen; test the key with the keyboard diagnosis (section 8.3)
The whole keyboard is dead	Loose keyboard cable; encoder fault; a foreign body under a key	Reseat the keyboard cable; remove the foreign body; return the controller for service
The USB stick is not recognised	Faulty stick; faulty socket; loose cable	Try another stick; reseat the USB cable; return the controller for service

Warranty and Service

Warranty

Cruxweld Industrial Equipments Pvt. Ltd. warrants this controller against defects in material and workmanship under normal use and service. The warranty period and its terms are those stated on the invoice or in the supply contract.

The warranty does not cover:

- damage caused by wiring that does not follow this manual, in particular an arc-voltage signal taken directly from the electrode and the workpiece, or an arc-start line without an isolating relay;
- damage caused by an unearthed or badly earthed installation;
- damage caused by a supply outside the stated limits, by water, by cutting fume, by corrosive substances or by mechanical impact;
- equipment that has been opened or modified without authorisation;
- consumable and wearing parts.

Before you call for service

Most calls are settled in a few minutes if the following information is at hand:

- the model and the serial number of the controller;
- the software version, shown in the system-definition screen;
- the plasma source and the consumables in use, and the plate thickness;
- exactly what is displayed when the fault occurs, including any alarm code;
- what has been tried already, and what changed just before the fault appeared.

Wherever possible, run the input and output diagnosis (sections 8.1 and 8.2) before calling, and have the results ready.

Returning equipment

This product is not designed to be serviced in the field. Return it to the Cruxweld service centre for any repair work. Pack it in its original packing or in equivalent protective packing, and enclose a note describing the fault and the conditions under which it occurs.

Spare parts and accessories

Item	Remark
Arc-voltage divider board	50 : 1 or 100 : 1
NPN proximity switch, DC 24 V	For initial height sensing
Torch lifter and DC 24 V motor	45 W or 200 W
Wireless remote control set	P2P, 8421 or RS232 receiver
RS232 serial port	Factory-fitted option; state it with the order
Tube and plate module	Software option; state it with the order
Shield collision detection	Option for the torch height controller

When ordering spares, always quote the model and the serial number of the controller.



INDUSTRIAL EQUIPMENTS PVT. LTD.

DynaCut ProX

CNC Shape Cutting Controller with plasma torch height control

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Cruxweld improves its products continuously. The technical and hardware data in this manual may change without notice.

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