CNC   Control

MAXI 4.0

Control Maxi 4.0

It is well known that we have several decades of experience in the construction of woodworking machinery and that our CNC cross-cut systems are among the best in the world.

This has become obvious, in particular, to the now more than 900 users of our CNC cross-cut systems around the world.

But all too few realize that one of the reasons for their excellence is that we have continuously used our wide experience in the development of the CNC controls.

Because we are so well aware of the problems that arise in woodworking practice, when developing the PAUL 11, 14, 18 and PushCut series CNC controls, we set ourselves the ambitious objective of achieving

Fig. 3: *Computer of MAXI control*

a control that was capable of more than just optimizing the cross-cutting results.

We sought also to optimize operation, handling, data exchange, service, and much more besides.

The outcome of the development work we did on the **MAXI** is the version **4.0**, which is without doubt the very finest of CNC cross-cut saw controls available today - a high-performance control offering the utmost ease of operation.
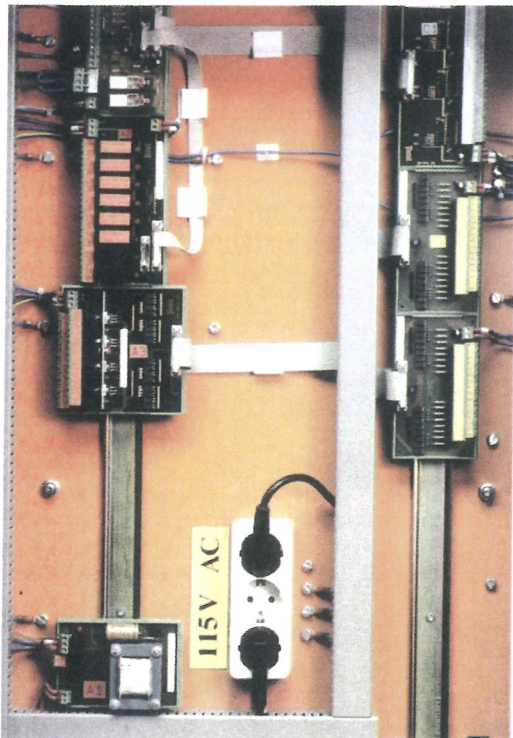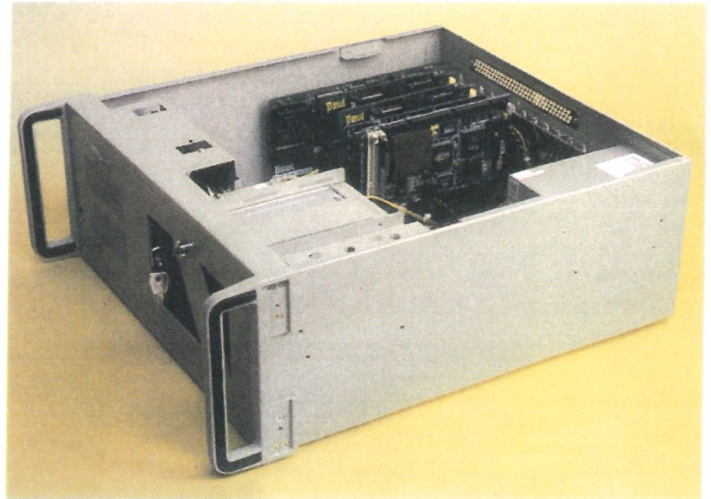
It allows, for example, for all machine functions to be controlled from the dust-tight keyboard on the front panel.

Operation is menu-guided following logical criteria, and is clearly structured.

The control facilitates rapid response to errors and serves to simplify their correction.

A typical example of the optimization of the controls is the interface technology that we have developed. A glance in the **MAXI**'s interior shows how clearly arranged and easily accessible are the modules that transmit the input and output signals. LEDs indicate that these are functional. Optocouplers and relays provide for the suppression of spurious signals and protect the processor from disturbances.

Fig. 4:
View of the interior of the operator terminal. Clearly arranged and easily accessible.

Illustrations on front page:

Fig. 1 : MAXI terminal

Fig. 2 : Display of "optimization result"

Fundamental modes of optimization

Partial optimization

With partial optimization the machine cuts the longest possible preset lengths of the cutting list that can be taken within a marked board section or out of any remaining piece left over - without taking account of the amount of waste that would be produced or any priorities.

If it is required to restrict the amount of waste, a maximum permissible waste length can be entered. In this case the machine will either cut several shorter fixed lengths or finger-joint lengths.

It is a feature of partial optimization that the longer lengths have maximum priority.

Full optimization

The full optimization feature with the MAXI 4.0 makes it possible to effect value or price optimization. A priority value which can be a price in any currency or a fictitious value is assigned to each fixed length to be cut.

The more pieces are required of a given fixed length, the higher must be the assigned priority value. The control selects that combination of lengths that achieves the highest possible sum of priorities.

This leads to a lower amount of waste or finger-joint lengths than on partial optimization.

Quality optimization

This is the furthest developed optimization procedure and also the most complex.

For this form of optimization to be possible, it is necessary for the lumber to be marked with code lines to indicate the limits of the various quality grades. The control then calculates how best the sections with the highest grade marking can be cut and allocates any remaining pieces to the adjacent lower grade sections.

Within the individual grade sections full optimization is used. Any remaining pieces - that would otherwise be waste - result in longer fixed lengths in the next lower grade sections and so increase the yield as against 'normal' full optimization.

Partial optimization

Full optimization

Quality optimization

Q1, Q2: Qualities   F: Fixed lengths   V: Loss   A: Waste
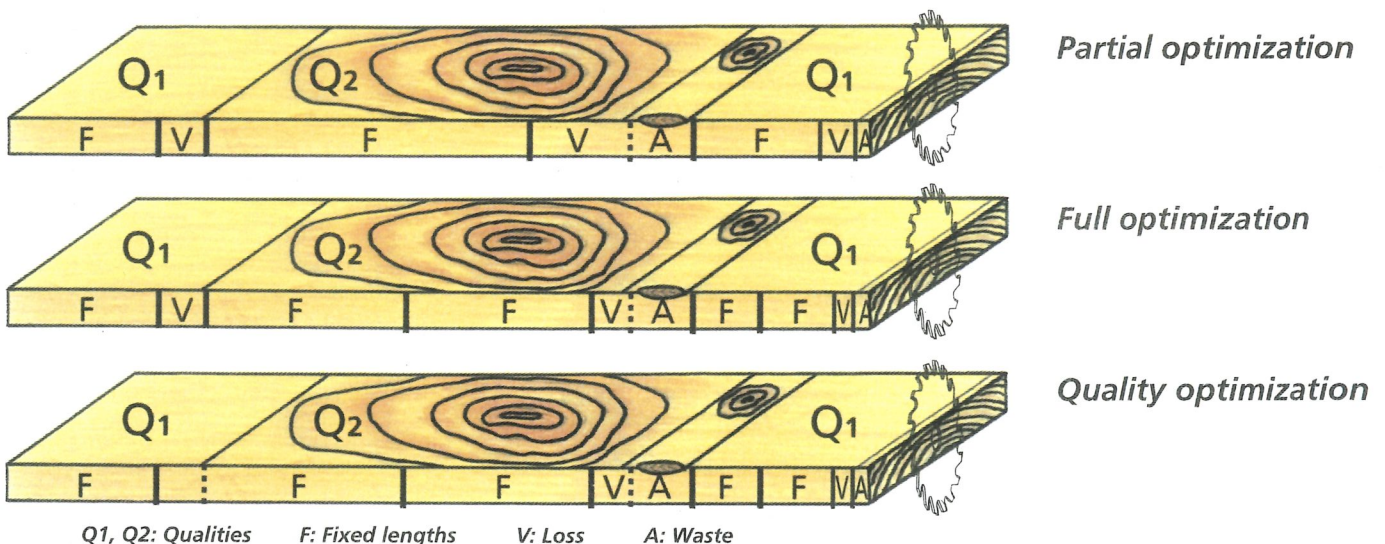
Optimization from A to Z

Auto-adaptive priority control

The MAXI 4.0 uses special software that ensures that (→) cutting lists are worked through uniformely. This is particularly advantageous when a disproportionately large number of one particular length is to be cut and only very few of other lengths. In such cases the control automatically sets (→) priorities to ensure maximum lumber recovery – it is, in fact, auto-adaptive.

Board-width groups

Board widths can be distributed to a total of 16 groups and several (→) cutting lists can be assigned to each such group.

Buffer memory

The software stores in a buffer memory the data concerning the last 5 to 10 boards that have been cut. The contents of this memory can be displayed graphically. This makes it possible, even after work is completed, to check measured values and the optimization results.

Crayon lines

To mark defects and apply line codes to the lumber, we supply special crayons (→) Defects).

Cutting lists

The software can process up to 40 cutting lists with a maximum of 1000 preset lengths which can be distributed to the cutting lists as required. Each cutting list details the quantity of each length to be cut, values/priorities, sorting stations (option) and printing code (option). If the measuring station is equipped with a laser width measuring system, it is possible to assign the cutting lists to a total of 16 width groups.

Data exchange

The computer is equipped with a 3.5" disk drive so that it is possible, for example, to prepare (→) cutting lists on some other PC and to read them into the MAXI computer. Data exchange in the other direction is also possible. For instance, production (→) statistics can be saved to a disk and printed out or analyzed on another computer. Data can also be exchanged with a host or other computer directly by way of the serial interface.

Fig. 5:
Operator terminal with supplementary keyboard

Defects

Defects in the lumber are mostly marked manually with (→) crayon lines which are recognized by a luminescent scanner. On models 18E and 18GE this is effected by means of a non-contact laser guide light. As an option, defects can be detected automatically by an optical scanner which transmits the necessary information to the MAXI control. (→ Data exchange)

Error messages

Error messages are displayed on the monitor screen in plain language. This facilitates rapid response. Errors are easily corrected via the (→) Help key.

● Finger-joint grades

It is also possible to classify under various grades (→ qualities) the material that is meant for finger-jointing.

● Finger-joint lengths

A minimum and a maximum finger-joint length (or reusable remaining length) can be entered for different grades.

● Help key

The MAXI 4.0 menu is so designed that the operator can ask for help in any position.
Pressing the 'F1' key causes a text to be displayed on the monitor that gives explanations, instructions and tips relative to the situation concerned.

● Infeed length identification

On machines with full optimization having this feature, up to eight light barriers, about 3" apart, detect the length of each piece of material fed into the machine and transmit this value to the computer. The advantage here is that the cross-cutting system can be shorter

in length and thus less expensive, however, it does not allow for defect removal.
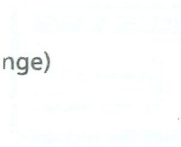
● Input and output signals

The transmission of input and output signals is indicated by the lighting of LEDs on the modules concerned.
This provides an additional diagnosis aid in the event of a fault arising.

● Interface

(→ Data exchange)

● Keyboard

The operator keyboard is on the front panel of the control cabinet. It is absolutely dustproof and has such large keys that they can be actuated without difficulty when wearing working gloves. This keyboard serves to program and operate the cross-cut system (→Operation).

● Lateral mark recognition

The series 11 and 14 cross-cut systems can be equiped with an additional luminescent scanner to recognize crayon marks on the edge of the board. In this way it is possible to apply defect markings to the top face and the quality markings to the edge of the board and so e.g. to cut out very small defects.

● Measuring station

The full length of the board, the position of any defect markings, and of any quality markings, are measured and transmitted to the computer before cutting begins.
As an option the measuring station can also be equipped with a (→) width measuring feature for automatic board-width identification.
Measuring station MIII is included in the standard configuration and suitable in most cases.
Measuring station MI is provided where a split infeed belt conveyor is required due to the use of an opto-electronic width measuring unit.

● Menu guidance

Clearly structured menu guidance in (→) windowing menu technique serves as an aid to the operation of the MAXI control.
Just pressing a key brings the required menu to or deletes it from the monitor screen. Each menu offers a choice of functions or input possibilities that again can be activated from the keyboard.
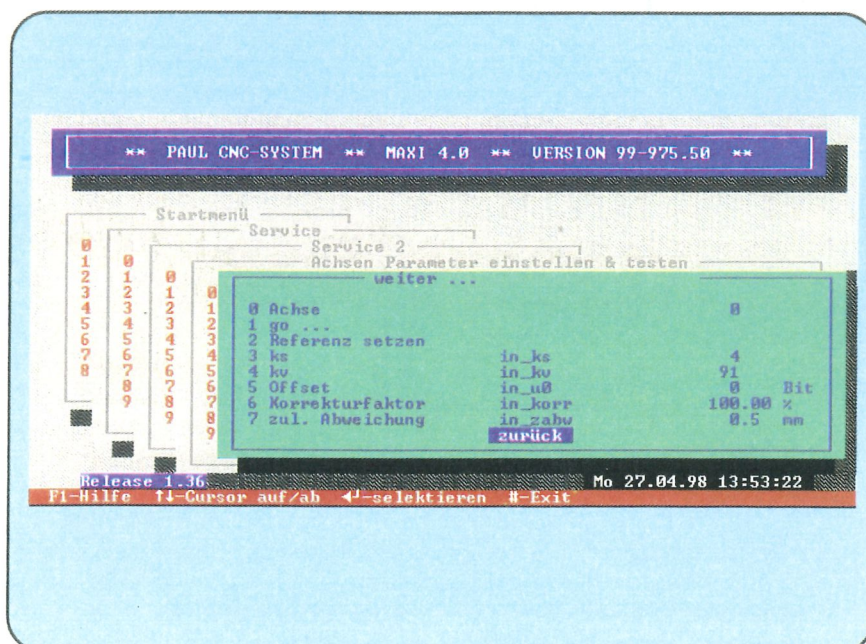

Fig. 6:
Menu guidance in
windowing technique

Non-volatile memory

Even in the event of power failure or electrical disconnection of the computer, the data stored in the data memory will still be held. There is thus no risk of valuable data - e.g. production statistics, cutting lists - being lost.

Operation

Operation of the CNC cross-cut system is remarkably simple. The data needed to program the cutting lists as well as control commands are entered by way of the dustproof numeric keypad and function keys or are simply loaded from a disk. The keyboard on the front panel of the control cabinet has such large keys that they can be pressed without difficulty when wearing working gloves.

Operator terminal

The standard version of MAXI 4.0 CNC control comprises a personal computer, a high-resolution color monitor, a keyboard, and the necessary software. To protect the sensitive electronic components from dust and moisture, these are accommodated in a control cabinet. The front panel also has a numeric keypad and a number of function keys by means of which the entire cross-cut system can be operated. There is space at the bottom of the terminal to accommodate a printer (option) by means of which (→) cutting lists and production (→) statistics etc. can be printed.

Optimization objectives

The MAXI 4.0 offers a choice of four optimization objectives:

- (→) Wase minimization
- Optimization with (→) priorities
- (→) Quality optimization
- Value/Price optimization

Parameters

Parameters are values that determine the mode of operation of the machine in some particular (selectable) respect such, for example, as saw stroke time, length of trim cut, etc.

Password

Certain functions can only be effected after first entering a password. This is to prevent sensitive data (such as parameters) being unintentionally or inappropriately altered.

Power failure

(→) Non-volatile memory

Priorities

By setting priorities it is possible to influence the quantities of the various lengths to be cut. If, for example, a shorter length is needed more often than a longer one, then the shorter length can be given a higher priority and the computer will not then determine the combination of lengths that gives minimum waste, but a combination where the sum of the assigned priority values is highest.

Qualities/Grades

The MAXI 4.0 can register and process up to eight different lumber grades.
Crayon line codes are used to mark the different grade sections within which the control will optimize and to switch automatically to the associated cutting lists. (See also fingerjoint grades)
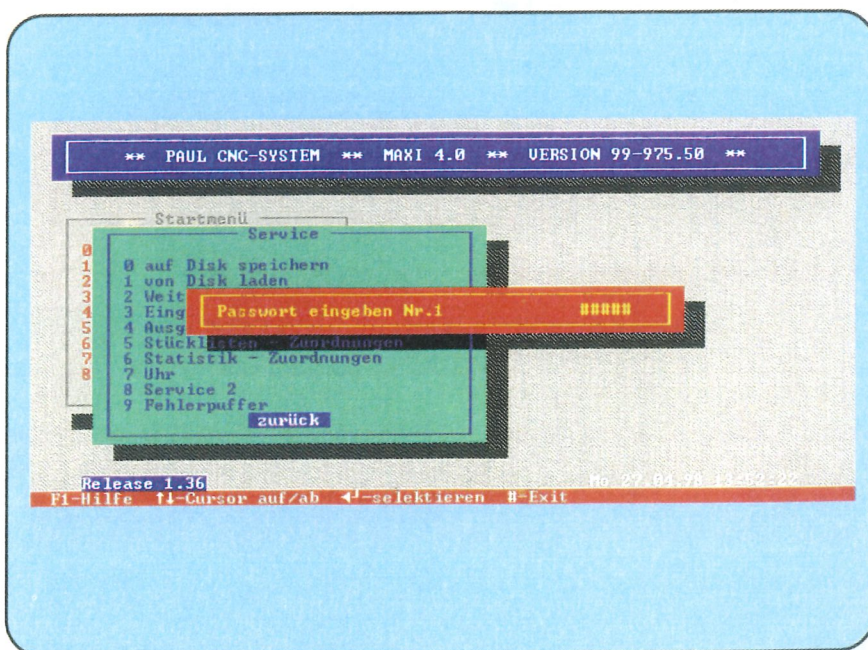

Fig. 7: Monitor screen: "Enter password"

● Reasonability check

The software checks the data that are input to prevent inadmissible values being input. If some inadmissible value is entered, a warning message is displayed on the monitor screen that also indicates the maximum and minimum acceptable values.

● Run Control

This term refers to the special hardware that constantly checks that the computer is functioning correctly.

Immediately an error is detected the entire system is brought to a fail-safe condition. This is to avoid the possibility of operators being endangered.

● Self-check function

The computer constantly checks the functionability of the entire cross-cut system.

For example, it checks that the photocells and luminescent scanners are not obscured by dust or dirt, and that the measuring systems, compressed-air supply, limit switches, motor circuit breakers and emergency stop switches are in order.

If a machine guard is opened, an appropriate message is displayed on the monitor. (➜ Error messages).

Simulation

● The simulation program makes it possible to calculate in advance the probable outcome of a cutting operation.

Fig. 8:
Monitor screen:
"Selfcheck"

For the simulation the computer uses the data of a reference lumber stack as well as the necessary cutting data (cutting list). Without actually cutting, it calculates how the lumber would be cut and details the result of its calculation board by board.

The advantage of such a simulation process is that the cutting result can be influenced before the actual work starts. Depending on what the reason for an undesired result is, it can be improved all before a single board has been cut.

● Sorting

The MAXI 4.0 can control any of the sorting systems that Paul supplies. This means that cut lengths can be allocated to any of up to 99 sorting stations. Before sorting the control checks that the lengths to be sorted correspond to the programmed lengths. On the detection of any broken or split piece, such as may occur with oak, the computer brings the system to an immediate stop to avoid serious damage being done to the sorting equipment.

After a few seconds the system will restart automatically.

● Statistics

Statistical data are stored by all the controls of the MAXI series. This means that these controls keep a record of all work that is done and on completion of any production run (or on long jobs during the work as well) it is possible, by just pressing a key, to call up, print out or store a statistics report which includes invaluable information for costing and documentation.

● Supplementary keyboard

An additional standard keyboard, by means of which alphanumeric data (e.g. job number, printing code of an ink-jet priner etc.) can be entered, is accommodated in a dustproof drawer in the operator terminal.
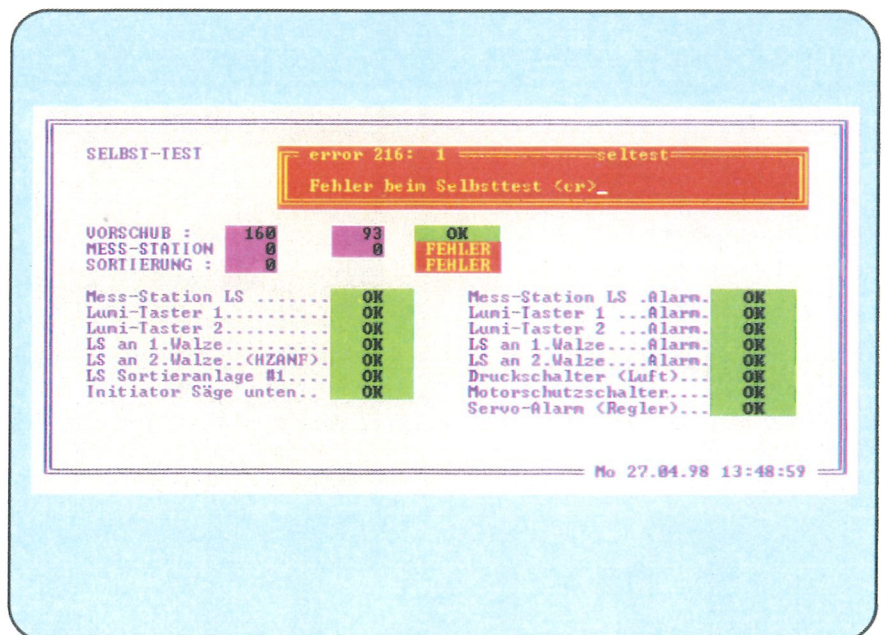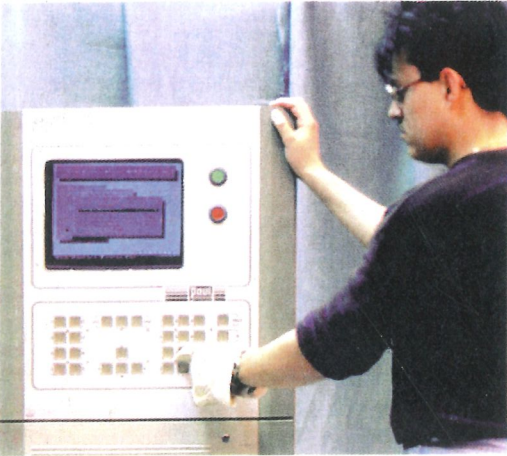
● Warning messages

(➜) Reasonability check

Fig. 9: Keyboard

Waste

Waste arises when a piece of lumber is shorter than the shortest fixed length or than the specified minimum (➜) finger-joint length. Longer waste lengths are left in one piece; shorter ones are cut up for firewood whose length can be programmed.

Waste minimization

Reduction of waste is one of the selectable (➜) optimization objectives. When this option is selected the control combines the entered fixed lengths in such a manner that waste is minimized.

Width measurement

The (➜) measuring station of the model 11 MKL and 14 MKL cross-cut systems can be equipped with an opto-electronic (laser) width measuring system that will measure the width of the lumber as it passes through irrespective of its thickness. The measured values are transmitted to the control where they are further processed.
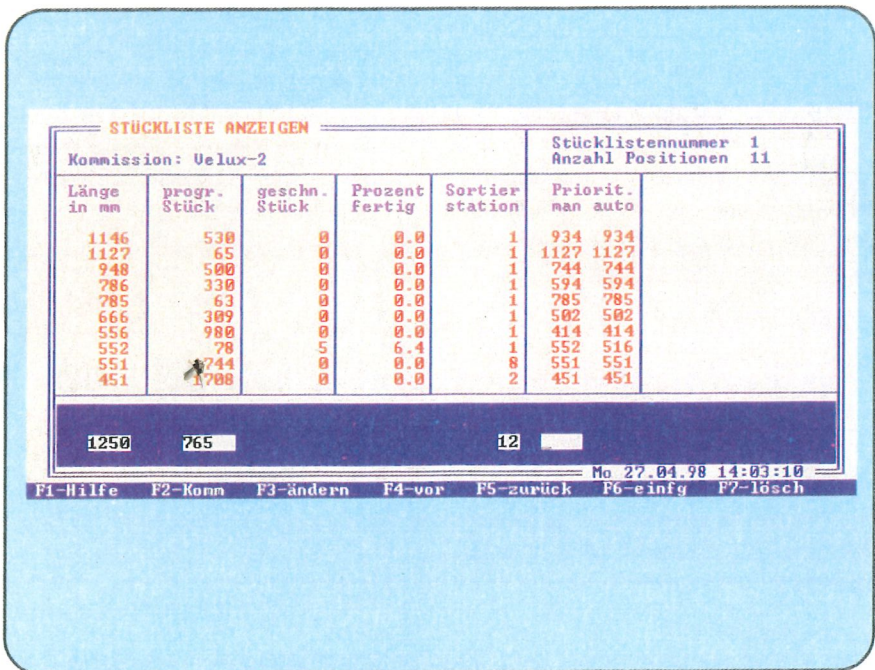(➜ Board-width groups).
An optional triangulation measuring system is available in cases where a maximum width measuring range of 180 mm is sufficient.

Windowing menu technique

The MAXI 4.0 menus are so designed that on a key being pressed a second menu (a window) is opened to detail a choice of functions or commands that are numbered to facilitate selection by pressing the appropriate number key and thus cause a second window to be superimposed on the first or to be closed again.

This 'Windows' menu technique simplifies operation and the entry of data into the control. (➜ menu guidance)

Fig. 10: Monitor screen: "Display/enter cutting list"