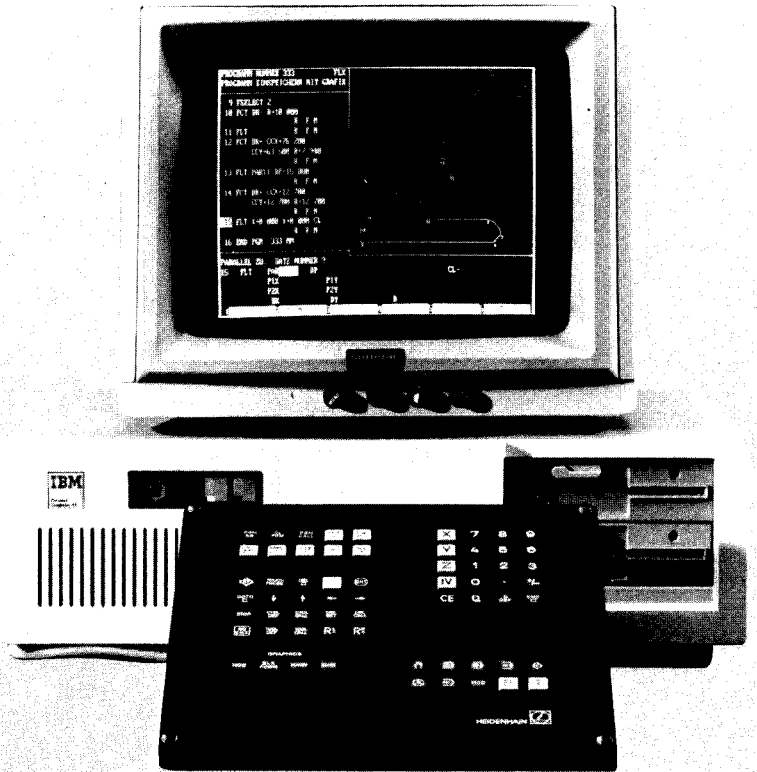


HEIDENHAIN

User's Manual

FlexK

Programming Station for TNCs

March 1994

General Conditions for Use

1. By paying the purchase price, the purchaser does not acquire the program itself but only a temporally unlimited right to use the program.

2. The buyer is permitted only to make copies of the installation disks only for backup purposes and to copy it to his hard disk. It is forbidden to sell such copies to third parties. All rights of ownership are retained by the manufacturer.

3. Transfer of the right to use the program to a third party requires the express written consent of the manufacturer. The transfer voids the right of use for the original purchaser. All backup copies must either be given to the transferee along with the originals, or destroyed without delay; the manufacturer must also be informed of this accordingly.

4. The manufacturer assumes no liability for damages of any kind resulting from use of this program.

Contents

1 Items Supplied

FlexK is supplied as:

- The FlexK software on a 5 1/4" or 3 1/2" floppy disk.
- HEIDENHAIN TNC 355 keyboard with connecting cable to the PC.
- Adapter card for the HEIDENHAIN keyboard: either for AT or PS/2 systems.

The required RS-232-C connecting cable between the TNC and PC is not included in delivery. It can be ordered in the desired length under the part number Id.-Nr. 239 760 ...

2 Introduction

The FlexK software simulates the programming functions of the TNC 155 and TNC 355 on a PC and enables you to program contours not dimensioned for conventional NC.

Such contours must be completely defined mathematically. However, they are often not dimensioned such that the end points of the individual contour elements can be entered directly into the TNC as NC blocks.

FlexK makes it possible to evaluate the dimensions given on the drawing and transform them into a TNC program.

If a drawing is dimensioned for NC, you can program directly in HEIDENHAIN plain language format using all programming features of the TNC 155 and TNC 355.

The graphics show the programmed blocks in the working plane while you program them. Various colors indicate whether a contour is completely defined, undefined, or if more that one solution is possible on the basis of the programmed dimensions.

Fixed cycles, subprograms and parametric programs are not depicted.

Contradictory input is recognized and indicated with an error message.

TNC programs can be transferred via RS-232-C interface to the control or to the FE 401 B floppy disk unit.

FlexK requires a HEIDENHAIN keyboard and an adapter card for the PC.

3 Installing the FlexK Software

3.1 Required Hardware

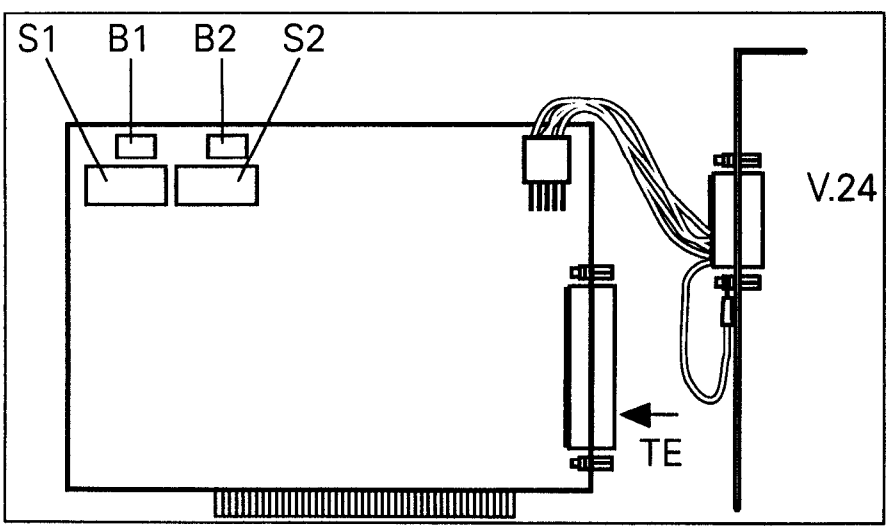
The following hardware is required to operate the software:

- Compatible PC (DOS 3.1 or later)
- Main memory min. 640K bytes
- Hard disk
- EGA/VGA screen
- Mathematical coprocessor

3.2 Installing the Hardware

The adapter card supplied for the HEIDENHAIN keyboard is installed in a vacant slot of the PC.

Use the following procedure to install the hardware:



DIP Switches for the Keyboard

Set the DIP switches for the switch wafer S2 and the bridges B2 for the port addresses of the HEIDENHAIN (applies only to adapter cards for AT computers).

The port addresses can be set in hex code in increments of 8 through the DIP switch S2.

S2/1	S2/2	S2/3	S2/4	S2/5	S2/6	S2/7	S2/8
Without function	0	0	0	0	0	0	0
	0	1	0	0	0	0	1
	1	0	0	0	0	1	0
	1	1	0	0	0	1	1
			.	.	.	.	.
			.	.	.	.	.
			.	.	.	.	.
			1	1	1	1	1

*100 Hex

* 8 Hex

0 means switch "ON"
1 means switch "OPEN"

The port addresses can be set from H000 to H3F8.

After you have set the port addresses of the hardware, you must then configure the software. (see Chapter 3.3).

The DIP switches are preset by HEIDENHAIN as follows:

S2/1	S2/2	S2/3	S2/4	S2/5	S2/6	S2/7	S2/8
ON	OPEN	OPEN	ON	ON	ON	ON	ON

OPEN means the bit is set!

This setting sets the port addressing range to H300 to H307.

The bridges B2a to B2e are always open.

DIP Switch for the RS-232-C Interface

Set the DIP switches of the wafer S1 and the bridges B1 for the RS-232-C interface.

The following settings are possible:

	S2/1	S2/2	S2/3	S2/4	S2/5	S2/6	S2/7	S2/8
COM1	ON	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
COM2	ON	OPEN	ON	OPEN	OPEN	OPEN	OPEN	OPEN
without RS-232	ON	OPEN	OPEN	ON	ON	ON	ON	OPEN

B1a	B1b	B1c	B1d
open	clsd	open	open
clsd	open	open	open
open	open	open	open

Most PCs already have an RS-232-C interface "COM1", therefore the setting for "COM2" is the correct one. If your PC has two RS-232-C interfaces (COM1 and COM2), you need not install the supplied RS-232-C connector. The correct setting is then "without RS-232."

Installing the Card

After making a final check of the DIP switches and bridges, you can begin installing the adapter card.

The adapter cards for PS/2 systems have no DIP switches or bridges. They are installed through the software.

Refer to the chapter on expansion cards in your PC user's manual before installing the card.

3.3 Installing the Software

3.3.1 Setting the Port Address for the HEIDENHAIN Keyboard

Port Addresses for AT Systems

The hardware setting of the port addresses was described above in Chapter 3.2. You must also assign the addresses in the software by creating an ASCII file with the name TF, in which the wafer 2 switch settings are registered. The switch settings are indicated with the words "ON" or "OFF" (=OPEN).

Example TF file:

ON OFF OFF ON ON ON ON ON

This is the factory default setting for address H300.

If FlexK cannot find any TF file when it starts, it will always access the address H300.

Port Address for Micro Channel Bus

For the adapter card to the IBM PS/2 model you can set the port address through the .ADF file. The .ADF file is included on the FlexK floppy disk.

To set the port address, proceed in the following sequence:

Copy the file @6AE5.ADF onto the copy of your reference disk. Insert the copy of the reference disk in the disk drive and start the PC. Set the desired port address with the "Change configuration" menu under menu item "TE 355 keyboard adapter."

The following addresses are possible:
H300 to H307; H308 to H30F; H310 to H317;
H318 to H31F.

A TF file is not required.

Refer to the section on configuration in the user's manual of your PC!

3.3.2 Setting the Port Addresses for the RS-232-C Interface

Port Address for AT Systems

The RS-232-C port addresses can be set only by DIP switch (see Chapter 3.2)

Port Address for Micro Channel Bus

To change the RS-232-C port address, use the reference disk and the "Change configuration" menu, menu point "RS-232-C addresses."

Eight different address ranges can be selected:

H3F8 to H3FF; H2F8 to H2FF; H3220 to H3227;
H3228 to H322F; H4220; H4227; H4228 to H422F;
H5220 to H5227; H5228 to H522F.

3.3.3 Copying FlexK to the Hard Disk

The following files are stored on the supplied floppy disk:

FLEXK.EXE	Name of the programming software
TNC.EXE	For transferring programs to the TNC
FDE.EXE	For transferring programs to the FE 401
FE.EXE	To format floppy disks to FE 401 format
NC_NAME.EXE	To adapt NC program names from older versions of TNC.EXE
@6AE5.ADF	Configuration file
DF	Parameter file

After you have set the port addresses and installed the adapter card, copy the above file onto the hard disk.

Proceed as follows:

Create a directory with the name "FlexK".
Copy the files FLEXK.EXE, TNC.EXE, FDE.EXE, DF, FE.EXE into the "FlexK" directory. Keep the original disk in a safe place!

Now you can start the programming software by entering "FlexK".

The NC programs created are stored in the directory "FlexK" under their DOS file names, which consist of the program name and a specific file name extension. Programs created with TNC.EDIT are given the extension ".HNC", programs from "FLX-EDIT" are given ".FLX", and for transformed programs the extension is ".HNC".

4 The HEIDENHAIN Keyboard

The HEIDENHAIN keyboard is connected with the PC through the provided cable. Be sure to secure the connection with the locking screws.

You will primarily use the HEIDENHAIN keyboard for programming. The PC needed only in certain cases. This manual indicates when the PC keyboard is necessary. The HEIDENHAIN keyboard has two keys that do not appear on the TNC 155 and TNC 355:

- A green LT key
- A blank green key

The LT key is needed for contour programming in the "FLX-EDIT" mode. It enables you to program straight lines that connect tangentially to the preceding contour.

The blank green key (replaces the position-value-capture key of the TNC) has the following function:

- If it is pressed before a path function key, it opens the dialog for a "flexible" contour element. These are designated FL, FLT, FC, FCT and FPOL.
- If it is pressed before a numeric key (1 to 6), it activates the corresponding function from the current menu at the foot of the screen (F1 to F6).

5 Contour Programming

5.1 General Information

HEIDENHAIN controls can accept contour elements only if their end-point coordinates are known.

Sometime the end points are not dimensioned but the contour is defined mathematically. This is where FlexK can help you!

In each block of the NC program you enter only the known dimensions in the appropriate places as they are given on the drawing. If the data insufficiently defines the contour element, the block remains "flexible," which means that it is not yet completely defined. If data that is entered several blocks later suffice to define the contour, the computer will calculate the coordinates of the transition points. A postprocessor run then transforms the FLX program into a TNC program.

The TNC program can be transmitted through the RS-232-C interface to the TNC control or the FE 401.

In the second operating mode "TNC-EDIT" you can edit programs in HEIDENHAIN plain language dialog, using all the programming features provided by the TNC 155 or TNC 355.

The screen graphic generates the contour elements while you program them. A simple color code indicates whether the contour is completely defined (white), is undefined (red), or if the entered data permit more than one solution (green).

Fixed cycles, (drilling routines, pocket milling routines etc.) cannot be depicted.

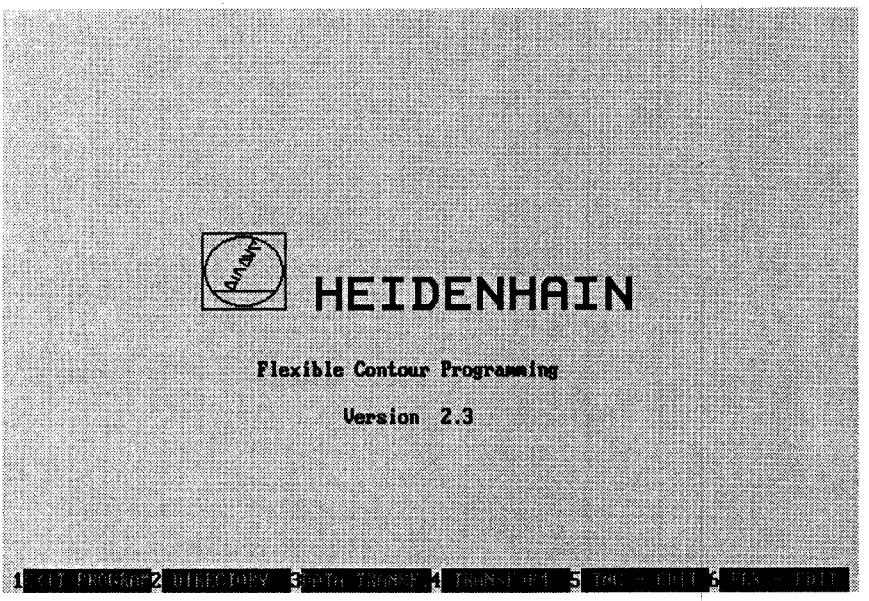
The screen immediately calls your attention to contradictory entries by showing an error message.

To acknowledge and clear an error message, press the CE key!

5.2 The Main Menu

After the program has started from the FlexK directory with the command "FlexK", the following screen appears:

Main menu



The HEIDENHAIN keyboard is used for all further functions, starting with this menu.

The menu items provide the following functions:

EXIT PROGRAM	Ends the work with "FlexK" (return to DOS)
DIRECTORY	Lists all TNC programs and FLX programs
DATA TRANSF.	Transfers a TNC program to the TNC or FE 401
TRANSFORM	Produces a TNC program from an FLX program

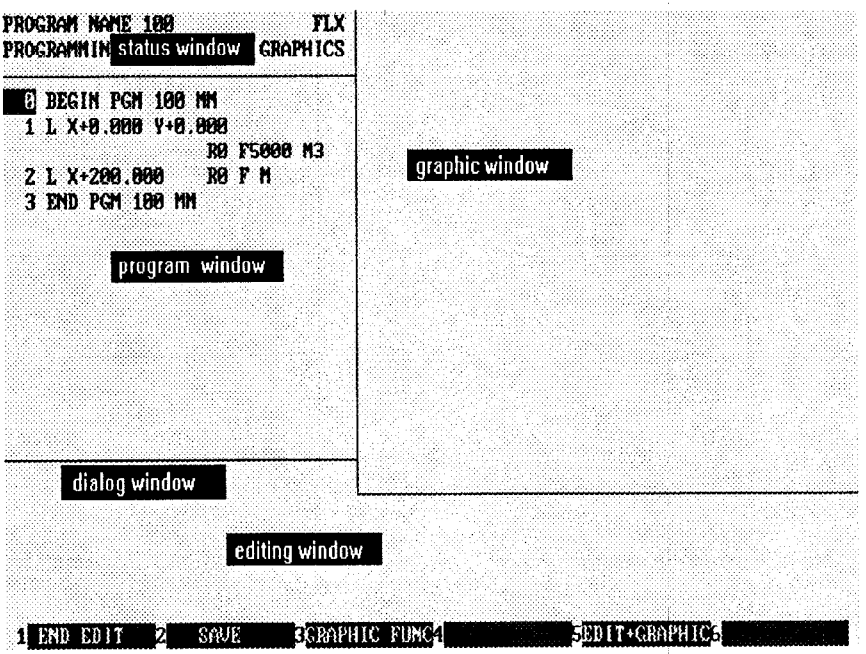
TNC-EDIT — In this operating mode you can write a program in HEIDENHAIN plain language. Only TNC blocks are permitted.

FLX-EDIT — In this operating mode you can write an FLX program with both TNC and FLX blocks.

5.3 Screen Layout for the Various Modes

The TNC-EDIT, FLX-EDIT and TRANSFORM modes use the following screen layout

Screen layout



Status Window

The status window shows the active operating mode (PROGRAMMING or TRANSFORM) and the active program number. Also, the message "WITH GRAPHIC" is shown when the graphic assistance is in operation.

Program Window

This windows lists the edited program or the program to be transformed. The current block is indicated by a block number in inverted form.

You can also use the window to select a desired program number via cursor key. During editing and transformation, the numbers of the available programs are shown here.

Graphic Window

The programmed contour is generated in the graphic window, provided that the graphic support in on. Parametric programs, subprograms and fixed cycles are not depicted.

Dialog Window

In the TNC-EDIT mode the dialog windows shows the TNC 155 and TNC 355 dialogs. In the FLX-EDIT mode it shows additional explanatory dialogs for further input.

Editing Window

All entries and changes in TNC and FLX blocks are made in the editing windows.

In light of the great variety of input for FLX blocks, it is no longer practical to read dialog prompts as in the TNC for each possible entry. The information is therefore entered in the appropriate input fields.

5.4 Creating NC Programs

Certain operating parameters are required in order to be able to write and graphically verify NC programs.

These operating parameters are stored in the parameter file "DF" (see Chapters 10 and 11).

5.4.1 TNC-EDIT Mode

After you have called the TNC-EDIT mode by pressing F5 , the screen format for the programming modes appears. All TNC programs are listed.

Use the cursor keys or type in the program number to call an existing program. Confirm your selection by pressing ENT.

To make a new program, enter a new program number.

The PGM NR key has no function.

As on TNC controls, programs can be protected from erasure. You can remove this protection by entering the code number 86 357.

Creating TNC Programs

TNC programs are written in the TNC-EDIT mode of operation and are programmed as on a HEIDENHAIN contouring control.

For a detailed description of TNC programming functions, see the TNC User's Manual. If the graphics are active, the contour will be depicted in the graphic window. A true 3D simulation of workpiece machining is not possible.

5.4.2 FLX-EDIT Mode

FLX programs are entered in the FLX-EDIT mode, which you call with F6. The difference between TNC-EDIT and FLX-EDIT is that in addition to all types of TNC blocks, the FLX-EDIT mode enables you to edit FLX blocks to program insufficiently dimensioned contour elements.

Creating FLX Programs

When you call FLX-EDIT, at first all existing FLX programs are listed.

Selected a program number to call a desired program into the text window. If, instead, you create a new program by typing in a number (maximum 8 digits), the program will ask you for the desired unit of measure.

```
MM=ENT / INCH=NOENT
```

If, for example, you press the ENT key for millimeters in a program with the name 123, the following text appears:

```
0  BEGIN PGM     123 MM
1  END PGM       123 MM
```

Now you can enter FLX and TNC blocks. Always enter TNC blocks when the contour is unambiguously defined up to the present position (white lines)!

Entering TNC and FLX Blocks

The input values for TNC blocks are also prompted in HEIDENHAIN plain language dialog in the FLX-EDIT mode. For FLX blocks, however, the program presents input fields in which you can enter geometrical data.

The following FLX blocks are available:

FL flexible straight line
FLT flexible straight line, joined tangentially to the previous contour
FC flexible circle
FCT flexible circle, joined tangentially to the previous contour
FPOL Pole for polar coordinates in flexible blocks

Since the end point of a straight line or of a circle in a flexible block is not calculable until subsequent FLX blocks are entered, every value that is not entered is defined as an unknown. If a value refers to the end point of a previous straight line or circle, then you must re-enter the end point coordinates. There are no modal coordinates!

Since a circle center can remain undefined in a FlexK block, it does not suffice to program it in one block for the subsequent blocks. If a circle center is not defined in a given block, it is considered unknown. Therefore every circle center that is known must be given in the corresponding FC or FCT block.

A pole may exist that is used to determine an end point or circle center in polar coordinates. This FPOL is valid until a new pole is given, i.e. it is modal. The dialog for an FPOL block is the same as the dialog for a CC block.

The Input Fields

The wide variety of possible input values for FL, FLT and FCT blocks are entered as geometrical data in various input fields.

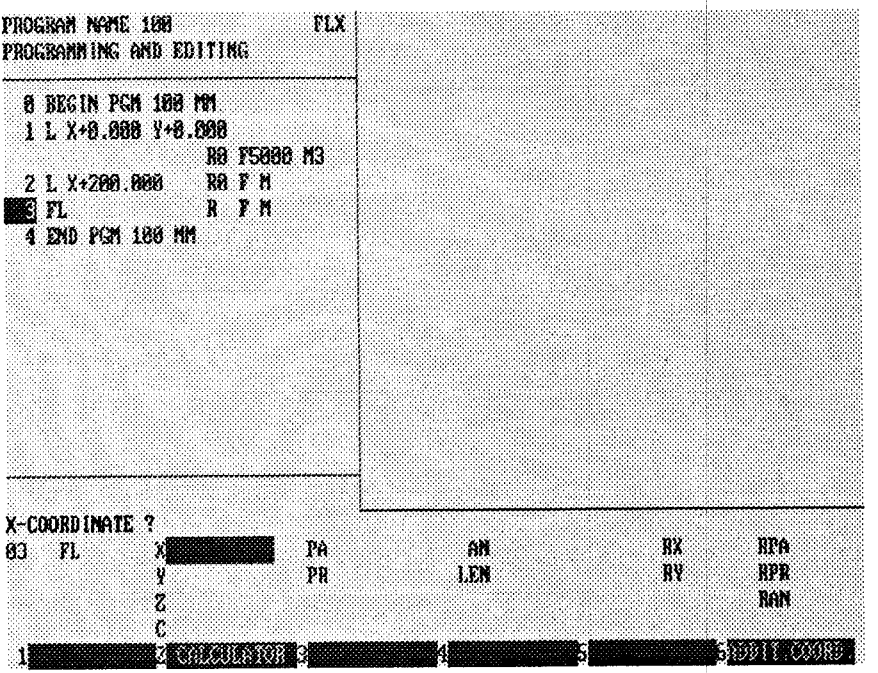
When you all an FLX block, the first corresponding input field appears. You can use the cursor keys to address the various positions within the field and jump to the second or third field. Press the END key to list an edited block in the program text window.

If you press ENT you must answer the dialog questions for radius compensation, feed rate and miscellaneous function.

Incorrect values can be erased with the NO ENT key.

The following examples refer to the XY working plane. If you choose another working plane, the input items will change correspondingly (e.g. CCY, CCZ in the YZ plane).

1. Input Field for FL, FLT, FC and FCT Blocks:



X	X coordinate (absolute and incremental)
Y	Y coordinate (absolute and incremental)
Z	Z coordinate (absolute and incremental)
C	4th coordinate (absolute and incremental)
PA, PR	Polar coordinates (absolute and incremental)
AN	Exit angle (absolute and incremental) For circles: tangent slope at start point
LEN	The length of a straight line Distance from start to end in a circular arc

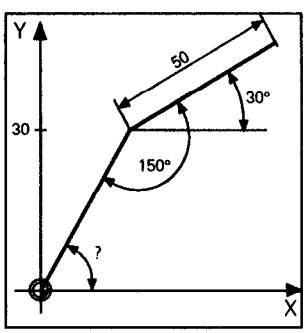
RX, RY, RPA, RPR, RAN — Number of a reference block if the incremental value is not referenced to the previous block

DR — Direction of rotation for FC and FCT blocks

The bottom line of the screen presents the following two further functions:

F2 CALCULATOR — For simple calculations such as addition and subtraction. Press ENT to see the result. To enter the "–" sign for subtraction, press the +/– key twice. The CE key clears your last entry. Press END to put the result of the calculation in the input field and end the calculator function.

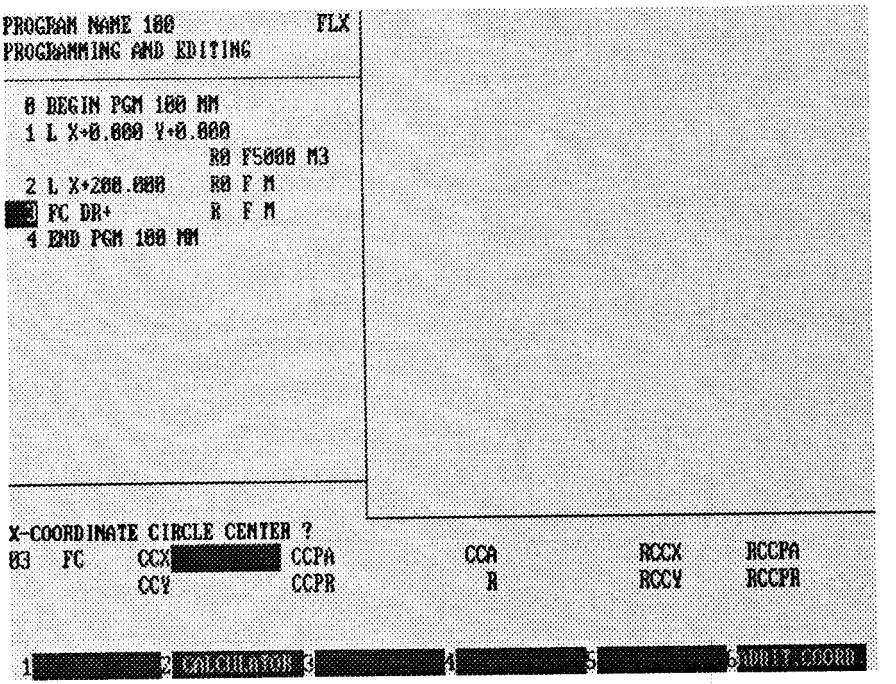
F6 ADDIT. COORD. — for input of absolute and incremental values in the same input field. In FLX blocks it may be necessary to enter both absolute and incremental values in the same input block. This double coordinate input is possible thanks to the "additional coordinate" function!



The angle of inclination AN is defined in block 4 in the example below both as 30° absolute and 150° incremental.

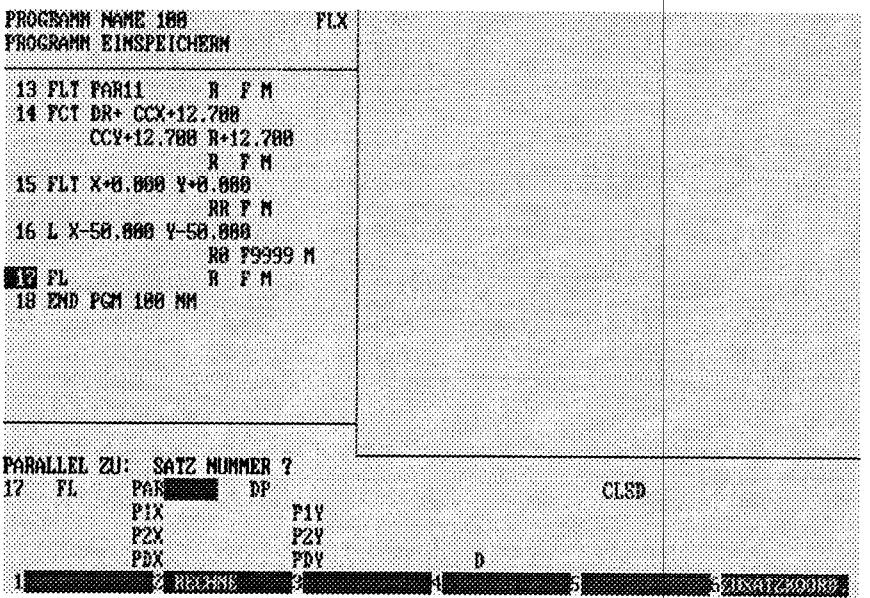
```
:
2 FL X0 Y0
3 FL    Y30
4 FL AN 30     IAN 150
  LEN 50  RAN 3
:
```

2. Input Field for FC and FCT Blocks



CCX	X coordinate of the circle center (absolute and incremental)
CCY	Y coordinate of the circle center (absolute and incremental)
CCPA, CCPR	Polar coordinates of the circle center (absolute and incremental)
CCA	Center-to-endpoint slope
R	Radius of a circle
RCCX, RCCY RCCPA, RCCPR	Number of the block to which the incremental value is to be referenced.

3. Input Field for FL, FLT, FC and FCT Blocks



PAR Block number of the parallel straight line (only for FL and FLT blocks)

DP Distance to the parallel straight line (only for FL and FLT blocks)

P1X, P1Y Coordinates of a point on a straight line or circle

P2X, P2Y Coordinates of a 2nd point on a straight line or circle

P3X, P3Y Coordinates of a 3rd point on a circle

DX, DY Coordinates of an auxiliary point

D Distance of a straight line or circle to (DX, DY)

CLSD Enter "+" in the first block, "–" in the last block for closed contours, if a reference is made (incremental value or tangential transition) between the two blocks.

Additional Functions

After entering a program number the following functions appear in the bottom line:

1 END EDIT	Saves the NC program and returns to the main menu
2 STORE	Saves the NC program
3 GRAPHIC FUN	Call the submenu for graphic functions
4 SOLUTIONS	Is displayed if there are several solutions to one contour.
5 EDIT+GRAPHIC	Switches on the graphic support

5.5 Graphic Support

The graphics serve the purpose of depicting the programmed contour. The color of a line indicates the following:

- A contour is complete and unambiguous (white), i.e. for a line the end point is known, for a circular arc the circle center and end point are known.
- A contour is undefined (red). The given data do not suffice to completely define it. The missing information must be entered in the same or in a subsequent block.
- A contour is ambiguously defined (green). The computer shows the various possible solutions for your selection.

The graphic contour simulation switches off and must be regenerated:

- After the block for a calculated contour is erased
- After the block for a calculated contour is changed
- After a block has been inserted in front of the current position, and whenever an error message is shown

Chapter 10 describes how you can use the MOD function to change certain settings in the graphics.

Graphic Functions

The size of the graphic window is determined in the "DF" file, but can also be changed via the BLK-FORM and the GRAPHIC-FCT (F3) graphic function. When you call GRAPHIC-FCT the following menu appears:

RETURN
Recalls the previous menu

ZOOM OUT+
Enlarges the graphic range, reduces the present image.

ZOOM IN–
Reduces the graphic range, enlarges the present image. Use the cursor keys to position the green frame to the desired section. To return to the previous position, press CE. The RETURN function enlarges the section within the green frame to full size.

SHIFT WINDOW
Moves the graphic window via cursor keys to a certain position in the graphic. Use RETURN to regenerate the screen with the new section.

CLEAR GRAPH
Erases the picture in the graphic window.

UNDO
Cancels all changes, including erasures. Recall the previous menu

Solutions

The information given in the FLX blocks do not always result in a single solution. You can provide the solution by entering additional values. If this is not possible, you can select the correct contour from a number of possible solutions shown in green. The SOLUTIONS function activates the following submenu:

RETURN
Recalls the previous menu. Pursues the shown solution.

WRONG SOLUT
Discards the solution shown. An FSELECT block with negative solution number is inserted below the current block. All other solutions remain open. If there are more than two solutions there may be a series of FSELECT block.

SHOW SOLUT
Shows the next solution.

SELECT SOLUT
Selects the contour currently shown in the graphic window. Produces an FSELECT block with corresponding number.

6 TRANSFORM

The TRANSFORM (F4) item in the main menu lists all FLX programs. Use the cursor to select the FLX program than you want to transform into a TNC program. Press ENT to start the transformation.

If the transformation is faultless it produces a TNC program that can be transferred to the control.

If errors arise during transformation, the process aborts and an error message appears. You must acknowledge and correct the error.

If a TNC program with the same number already exists it will be overwritten without warning!

Select RETURN to recall the main menu.

7 DIRECTORY

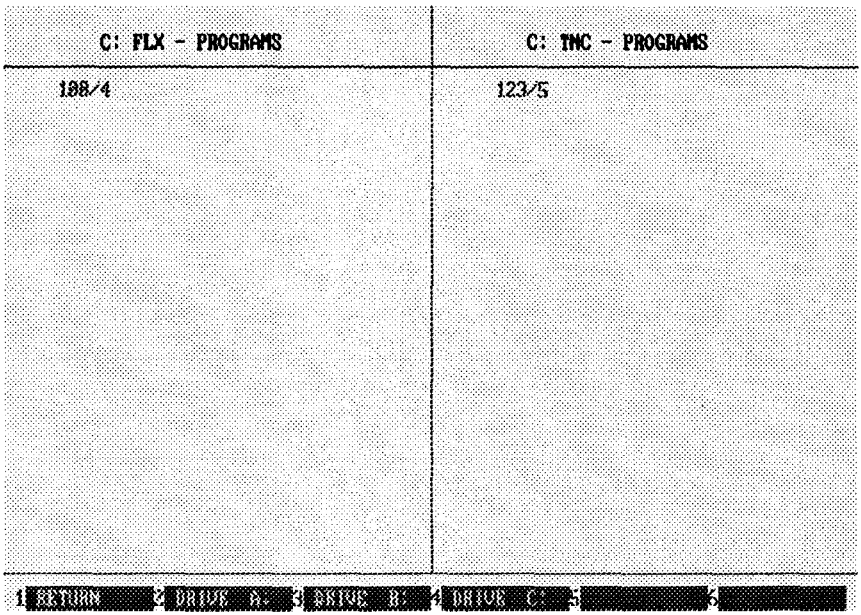
Select F2 in the main menu to list all FLX and TNC programs stored on drive A, B or C.

To access the drives from the submenu, select F2 for drive A, F3 for drive B or F4 for drive C. F1 recalls the main menu.

Note: newly created programs are stored on the selected drive!

The number of NC blocks in a program is indicated behind the program number.

Directory Overview



8 TRANSFER

TNC programs can be transferred to a TNC 155, a TNC 355 or to an FE 401 floppy disk unit through your computer's RS-232-C interface.

The TRANSFER (F3) item calls a menu from which you can transfer a program to a TNC (F3), to a floppy disk unit (F5) or to an FE-formatted floppy disk (F4).

8.1 Transferring Programs to the TNC

Configuring the Transfer Software

When you call the transfer program for the first time it prompts you to make certain required settings. It then automatically generates a file with the name Conf_TNC.TMT to save your input.

The settings are prompted in the following sequence:

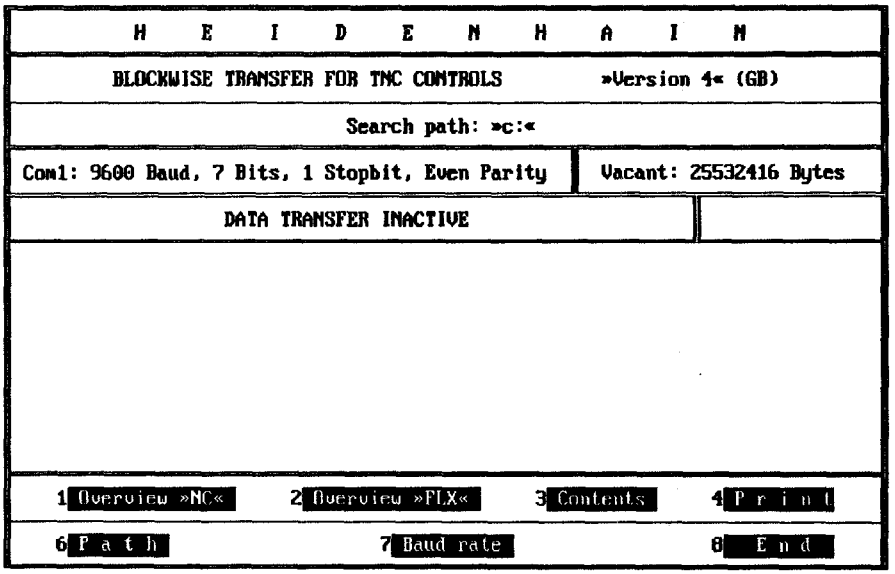
- Time out for block transfer [sec]
  Input value: 1 to 60 sec. (default is 30 seconds)
  Confirm with ↵.
  A delayed transfer process can be resumed within this time.
- Time out for character transfer
  Input value: 1 to 60 sec (default is 5 seconds)
- Is the connected control a TNC 407/
  TNC 415/TNC 425? [Y/N]
- Is a printer connected? [Y/N]
- Is the printer connected to LPT1? [Y/N]
- Under what name is the printer configured? (PRN or PRT)
- Transmit "Form Feed" when printing? [Y/N]
- Screen image: Monochrome or color? [M/C]

- Display transfer? [Y/N]
- Interface for transfer: COM1 or COM2?
- Baud rate: 9600, 19 200, 38 400
- Path
  The path can be selected from a displayed "tree" or typed in directly.

These configuration settings can only be changed by erasing the file `Conf_TNC.TMT` and re-entering the settings.

Only the baud rate and the path can be changed with functions F6 and F7.

Once all settings are made, the following screen appears:



This program can be operated only from the PC keyboard.

The transfer software function in the "blockwise transfer" mode of operation. This enables you to transfer programs with over one thousand blocks.

Use the MOD key of the TNC to set the V-24 interface at the TNC to "FE". For the older versions of the TNC 151/155 (A/P versions) you must set the following machine parameters:

MP 71	=	515
MP 218	=	17736
MP 219	=	16712
MP 220	=	279
MP 221	=	5382
MP 222	=	168
MP 223	=	1
MP 224	=	4

Baud rate = 9600

The PC and TNC should be connected through the data transfer cable Id.Nr. 224 422 01.

Before you transfer a program from the TNC to the PC, the decimal sign must be set to "." with MP 92 of the TNC!

A program that is transferred from the TNC to the PC does not appear immediately in the program name list of the DIRECTORY or TNC-EDIT displays. It can, however, be called by entering the program number in TNC-EDIT. When the call is repeated after this operating mode has been exited, the program number is included in the list.

Items F1 to F8 have the following functions:

DIRECTORY NC (F1):
Lists all TNC programs in the selected directory.

DIRECTORY FLX (F2):
Lists all FLX programs in the selected directory.

PGM-CONTENTS (F3)
Lists the blocks of a selected program.

TRANSFER (F5):

Recalls the opening screen of the program. With the PC in this state, you can start program transfer at the TNC (see the Operating Instructions of the TNC 155 or TNC 355). During transfer the message "blockwise transfer of PC to TNC" or "blockwise transfer of TNC to PC" appears in place of the message "data transfer inactive".

PRINT (F4):

Sends NC programs (N) or FLX programs (F) to an installed printer. You can interrupt printing by pressing ESC.

PATH (F6):

Changes the path that was set during initial program configuration. The new path is shown in the main menu.

BAUD RATE (F7):

Changes the baud rate. The new baud rate is shown in the main menu. Data bit, stop bit and parity bit cannot be changed.

8.2 Program Transfer to the FE 401 Floppy Disk Unit

The F5 function activates a program for program transfer from a PC to the FE 401 floppy disk unit and vice versa. Use the cursor to select and call the various menu items. This program is operated exclusively from the PC keyboard.

Com1:	H E I D E N H A I N	»Version 4« (GB)
	Search path: »c:«	
Data transfer Flexible disk unit ⟶ Calculator	Program directory of flexible disk unit Load addressed programs Load all programs	
Data transfer Calculator ⟶ Flexible disk unit	Program directory of calculator Output addressed programs Output all programs	
Monitor functions:	Provide data file(s) with write protection Remove write protection for data file(s) Delete data file(s) Show data file(s) Table of contents of a diskette Rename data file »99999967.X« Copy data file(s) from diskette to diskette	
General function:	Search path	
	P r o g r a m e n d	

For proper transfer the floppy disk unit must be set to FE mode (see the Operating Instructions for the FE 401). The PC and FE 401 should be connected with the data transfer cable (Id.-Nr. 224 422 01).

The menu items have the following functions:

Function Group: Data Transfer, Floppy Disk Unit → Computer

PROGRAM DIRECTORY OF COMPUTER:
Lists all TNC programs.

LOAD ALL PROGRAMS:
Transfers all programs from the floppy disk unit to the PC.

LOAD OFFERED PROGRAMS:
Transfers listed programs from the floppy disk unit to the PC.

LOAD SELECTED PROGRAMS:
Transfers selected programs from the floppy disk unit to the PC.

Function Group: Data Transfer, Computer → Floppy Disk Unit

PROGRAM DIRECTORY OF CALCULATOR:
Lists programs that are stored in a certain directory (see "Path").

OUTPUT ADDRESSED PROGRAMS:
Transfers selected programs to the floppy disk unit.

OUTPUT ALL PROGRAMS:
Transfers all programs to the floppy disk unit.

Function Group: Monitor Functions

PROVIDE DATA FILE(S) WITH WRITE PROTECTION:
Puts write protection on programs in drive 0 (upper drive) or in drive 1 (lower drive).

REMOVE WRITE PROTECTION FOR DATA FILE(S):
Cancels write protection.

DELETE DATA FILE(S)
Erases programs in the upper or lower drive.

SHOW DATA FILES:
Displays contents of programs to enable you to check for errors before starting transmission.

COPY DATA FILE(S) FROM DISKETTE TO DISKETTE:
Copies files from the upper drive to the lower drive.

TABLE OF CONTENTS OF A DISKETTE
Shows the directory of a floppy disk in the upper or lower drive.

RENAME DATA FILE "99999967.X" :
Programs that are transferred to the floppy disk unit in ME mode are given the collective number "99999967.X". These programs can be renamed into FE programs. This function is not applicable to FlexK!

For further information regarding the monitor functions, please refer to the Operating Instruction of the FE 401!

Function Group: General Functions

SEARCH PATH:
TNC part programs that were written with the FlexK program are stored in a certain path. This path can be changed at any time and is shown in the main menu.

PROGRAM END:
Terminates the data transfer program and returns you to the FlexK main menu.

8.3 Program for Formatting Floppy Disks in FE 401 Format

This program formats 3.5" floppy disks in FE 401 format to enable the FE 401 to read files that were copied to the floppy disk, for example from a hard disk. You can also copy in the reverse direction.

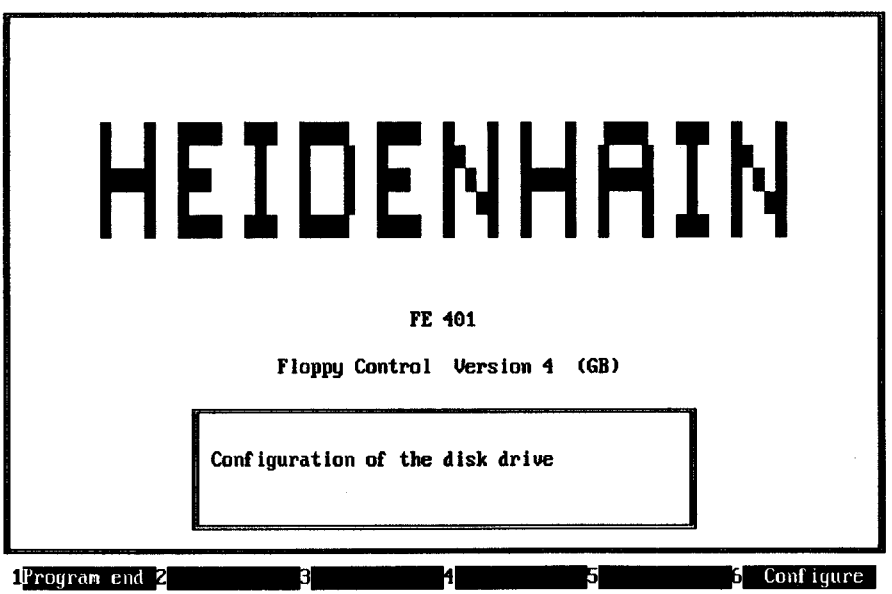
All necessary information is shown in windows. You operate the program via function keys and cursor keys. The input always applies to the active window, which is shown in a bright frame. The last screen line shows the current assignments of the F1 to F6 function keys. F1 is for ending the program.

Starting the Program and Configuring the Disk Drive

To start the program enter the command:

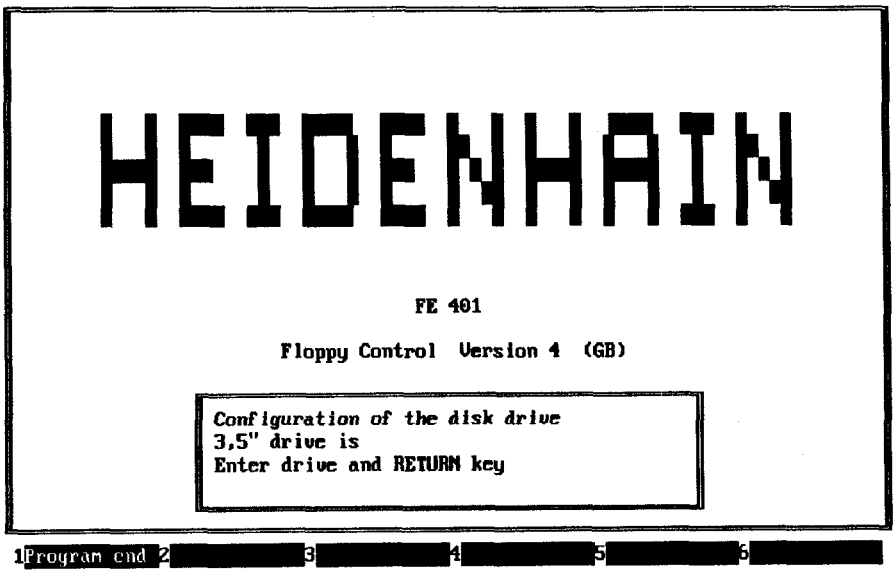
FE ↵

The following screen appears on the PC:



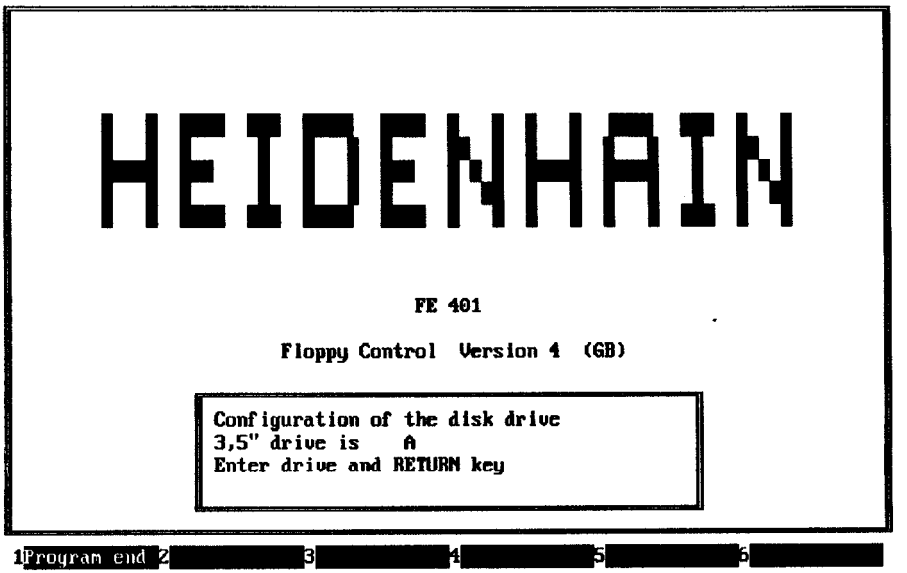
When you call the program for the first time, the 3.5" drive for the FE 401-formatted floppy disk must be configured.

Select F6 for "Configure" to call the following screen:



Enter the drive letter and confirm with ↵. The configuration is saved in the program so that it is always ready in subsequent program starts.

Once you have configured the drive, the following screen appears for all subsequent program starts:

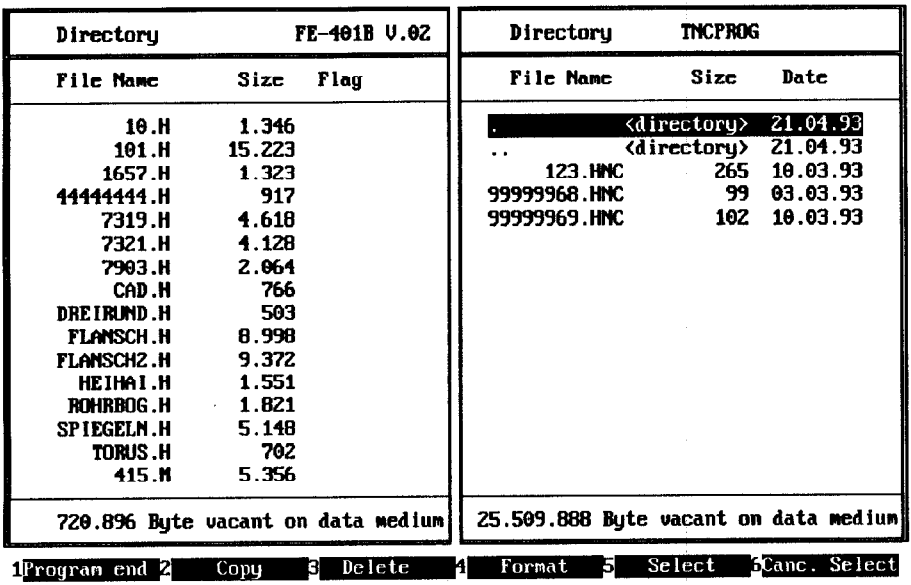


Confirm the displayed drive with ↵, or select F6 to reconfigure the 3.5" drive.

Directory Display

After the 3.5" drive has been configured, the screen shows the directory of the FE 401 disk (FE window) at the left; the directory from which the program was started is shown at the right (DOS window).

If there is no disk in the drive, or if the disk is not formatted, this will be indicated by an error message.



All existing subdirectories are displayed above the NC files in the DOS window. You can use the cursor keys to move around in a window, or also to switch to the other window.

↓	Down 1 line
↑	Up 1 line
←	FE window
→	DOS window
Page ↓	1 screen down
Page ↑	1 screen up

Every time you change to the FE window the program checks whether the disk has been changed. If so, the directory of the new 3.5" disk is shown. The program will show the directory of a new disk only if you select the FE window after it has been inserted. The flags mean:

"P" write protected
"W" write enabled

In addition to the FE and DOS windows, a status window, dialog window or error window appears, depending on the selected function.

A status window requires no input. A dialog window shows the possible entries. You can erase an entry with the BACKSPACE key, or you can overwrite it with another entry. Every error message must be acknowledged with the RETURN key.

Formatting the FE Floppy Disk

If you are in the FE window (cursor ←), you can format the inserted 3.5" disk in FE 401 format by pressing F4. The new disk name consists of "FE 401 V" and a random four-digit disk identification. The progress of formatting is shown in a window.

Selecting, Canceling a Selection

Press F5 to select a file that is marked by the cursor. To cancel the selection, press F6.

If a directory is selected in the DOS window, it becomes the current directory, and its contents are displayed. The expression "." represents the current directory, ".." is its parent directory. You can move through all branches of the tree by selecting the desired directory level.

Copying NC Files

All selected files in one window can be copied to the data medium in the other window. The target window is then reversed. The DOS directory shows only files with a name extension consisting of one character plus "NC".

During copying, the DOS name is changed as follows:

XXXXXXXX.HNC → XXXXXXXX.H

The name is changed conversely in the other copying direction. The file size is different for the same files, because the DOS file has two characters per line feed and the corresponding FE file has only one.

If a file is already present in the target window, this will be indicated by the program.

Deleting a File

All selected files can be deleted with F3. This applies to files both in the DOS and in the FE windows.

8.4 Auxiliary Program for Adapting a DOS Name to the NC Program

In earlier versions of the data transfer program TNC.EXE, the DOS name of the NC program was automatically lengthened to eight characters, the maximum permitted by DOS, by adding preceding zeros. In the present version of TNC.EXE, zeros are no longer added.

To transfer older programs with the new TNC.EXE program, the preceding zeros must be removed.

The auxiliary program `NC_NAME.EXE` will do this for you automatically. The program is started by entering `NC_NAME`.

Example:

00003553.HNC → 3553.HNC

Write-protected files and hidden files are also renamed. Machine parameter lists and PLC programs cannot be automatically renamed. We recommend saving the NC files with their old names on floppy disks as a safety precaution.

9 DF Operating Parameters

Certain parameters for the programming software are stored in the "DF" file. The DF file provided with the FlexK software is in German.

The following settings are made:

- Designation of the 4th axis:
  Possible input. A, B, C, U, V, W
  Default setting: `4. Achse C`

- Working plane
  Possible input: XY, YZ, ZX
  Default setting: `EBENE XY`

- Starting point for the graphics
  First input value for the X axis,
  Second input value for the Y axis
  Default setting: `STARTPUNKT 0.0 0.0`

- Size of the graphics window
  First pair of values: X(MIN, Y(MIN)
  Second pair of values: X(MAX), Y(MAX)
  Default setting: `WINDOW 0.0 0.0 200.0 200.0`

- Designation of the chamfer
  Possible input: L, CHF
  Default setting: `FASE L`

- Automatic FMAX input with ENT key.
  Possible input: FMAX ON, FMAX OFF
  Default setting: `VORSCHUB FMAX ON`

- Whether a feed rate should be programmed in an RND block.
  Possible input: VORSCHUB ON, VORSCHUB OFF
  Default setting: `RND VORSCHUB ON`

- Q parameter range for CALL-active OEM cycles in MP263 (see also Chapter "OEM Cycles" in the Technical Manual for your TNC)
  Default setting: `MASCHINEN-PARAMETER 263 = 10`

Example for a complete DF file:

```
4. ACHSE A
EBENE XY
STARTPUNKT 0.0 0.0
WINDOW 0.0 0.0 250.0 250.0
FASE L
VORSCHUB FMAX ON
RND VORSCHUB ON
MASCHINEN-PARAMETER 263 = 50
```

The DF file is a simple text file and can be written and edited with any text editor.

10 MOD Function

The MOD function enables you to overwrite the following default settings in the DF files:

PLANE
STARTING POINT
CHAMFER
FEEDRATE FMAX

The following settings can also be made:

STARTING BLOCK FOR GRAPHICS:
The starting block is the NC block from which the graphic display should begin.

CODE NUMBER
The code number 86 357 cancels the protection for a selected program.

GRAPHICS WITH BLOCK NUMBER
Press ENT to activate the block number display, NOENT deactivates it.

11 The DIALOG.TXT File

In order to program OEM cycles in the TNC-EDIT mode of operation, you must write a file named `DIALOG.TXT` . This file is not included on the supplied installation disk. `DIALOG.TXT` contains the dialog texts in sequence for the user cycles. The first text of the file is assigned to the dialog number 1, the second text to the dialog number 2, and so on.

The file `DIALOG.TXT` is a simple text file and can be written with any text editor.

You will find more detailed information on how to create cycles in the Technical Manuals for the TNC 360 and TNC 407/TNC 415 controls.

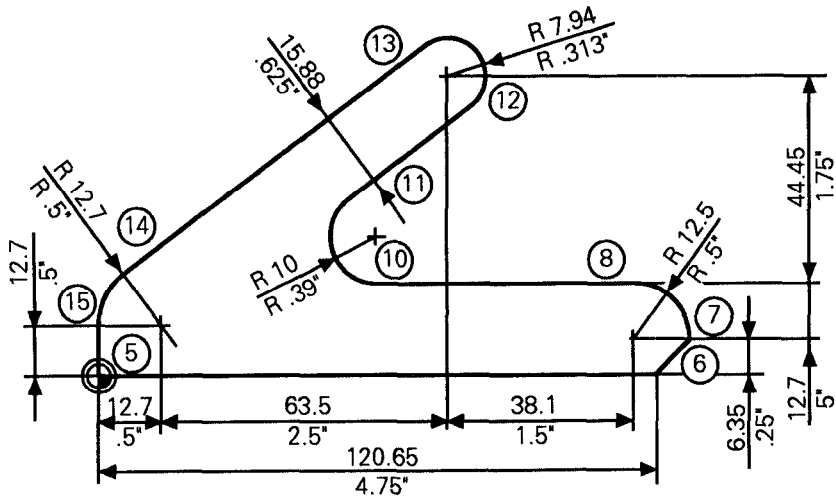
12 Programming Example

The following is an example of how an NC program can be written in the FLX-EDIT mode of operation:

After calling the FLX-EDIT (F6) mode of operation, you can assign a program number and a the working plane (in this example, X,Y). The programmed blank form "BLK form" determines, as on the TNC 355, the size and position of the workpiece in the graphic window. Technological data, which can be added later, have been omitted from this example for the sake of simplicity. The same applies for positioning in the Z axis. Only movements in the working plane have been programmed in this example.

The workpiece datum is at the lower left corner. This is where machining will begin.

Workpiece drawing
(O = block number)



The NC program then begins as follows:

```
0 BEGIN PGM 100 MM
1 BLK FORM 0.1 Z X-10.000 Y-10.000 Z-20.000
2 BLK FORM 0.2 X+150.000 Y+100.000 Z+0.000
3 L X-50.000 Y-50.000 RO FMAX M5
4 L X+0.000 Y+0.000 RR F500 M3
```

Programming with FLX blocks begins with block 5!

The contour is to be machined counterclockwise.

The next block is therefore:

```
5 FL X+120.650 Y+0.000 R F M
```

As mentioned before, coordinate values in flexible blocks are not modal. Y=0 must therefore be programmed again, otherwise it will be unknown!

For the next contour element only the gradient angle is available.

```
6 FL IAN-135.000 R F M
```

The graphic shows a red line, since the end point of the line is unknown.

Block 7 is a circular arc for which the center, radius and direction of rotation are known:

```
7 FC DR+ CCX+114.300 CCY+6.350 R+12.700 R F M
```

Since block number 7 provides the information needed to define the straight line in block 6, this line is now shown in white. The X coordinate of the circle center can be determined with the pocket calculator function.

Block 7 is shown in red, since the end point is missing!

The tangentially connecting straight line runs parallel to block 5:

```
8 FLT PAR5 R F M
```

The distance between the two lines need not be programmed (DP= [12.7+6.35]). As it happens, this information could provide two solutions. Use the SOLUTIONS (F4) function to view them (green lines).

The second solution is the correct one. Select F5 to save it, which creates the block:

```
9 FSELECT 2
```

Block 7 is now shown in white because it is completely defined.

For the following circular arc, only the radius and direction of rotation are known:

```
10 FCT DR- R+10.000 R F M
```

Block 8 and 10 remain red, since they are not yet fully defined.

There is no dimensional information given for the tangentially connecting straight line:

```
11 FLT R F M
```

Blocks 8, 10 and 11 remain red.

The following tangentially connecting circular arc

```
12 FCT DR+ CCX+76.200 CCY+63.550 R+7.940 R F M
```

still provides too little information to completely define the last three blocks. The contour remains red.

The following straight line is parallel to the line in block 11. The distance between the two lines (15.88 mm) need not be programmed.

```
13 FLT PAR 11 R F M
```

Up to now blocks 8, 10, 11, 12 and 13 are undefined and are shown in red.

Now the following circular arc finally defines all the previous contours and they are shown in white.

```
14 FCT DR+ CCX+12.700 CCY+12.700 R+12.700 R F M
```

Block 15 closes the contour at the workpiece datum.

Since the contours in blocks 5 and 15 need no reference to each other for their definition, you need not program the CLSD position!

```
15 FLT X+0.000 Y+0.000 R F M
```

Block 16 returns the tool to the starting position:

```
16 L X-50.000 Y-50.000 R0 F M5

17 END PGM 100 MM
```

The program is now finished and can be processed into a TNC program with the TRANSFORM function (F4).

HEIDENHAIN

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