

MT-CNC Handterminal BTC05

Application Manual

SYSTEM200

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10 Revisions to this Document

10-1

1 Introduction

The BTC05 is a portable control and display terminal for industrial applications. It is field bus compatible, features a large display and optimized ergonomics. It is therefore suitable for a great variety of tasks:

- Operator panel for machines and plants
- Teach panel for the testing mode of robots
- Setup device for drives
- Handheld device for machine tools

The BTC05 is programmed using the programming software shipped with the device. The handheld terminal can be connected by a serial interface. The programming of the handheld terminal in the Rexroth Indramat SPS is essentially simplified by the use of function blocks supplied with.

The handheld terminal is available in the following versions:

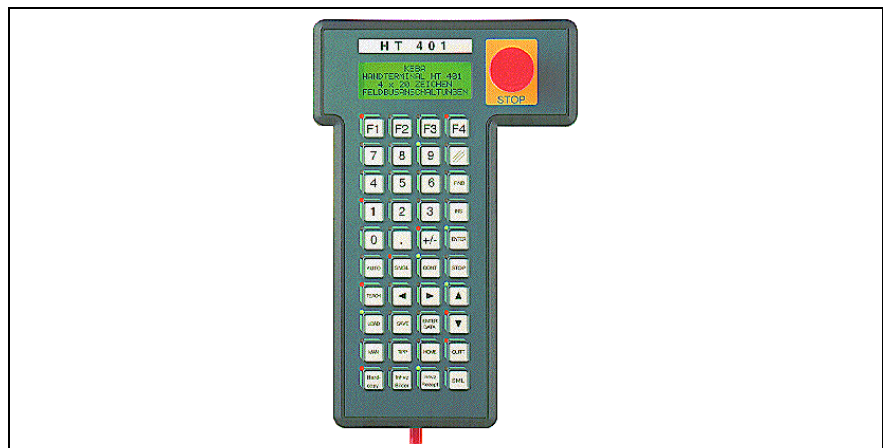


Fig. 1-1: **BTC05.1A-NN2-FW** - Display with 4 x 20 characters, 40 keys

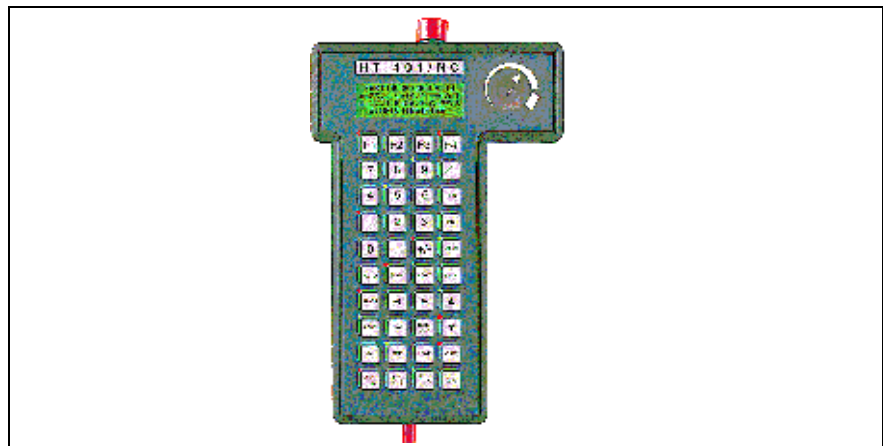


Fig. 1-2: **BTC05.1A-PN2-FW** - Display with 4x20 characters, 40 keys and additionally one override potentiometer

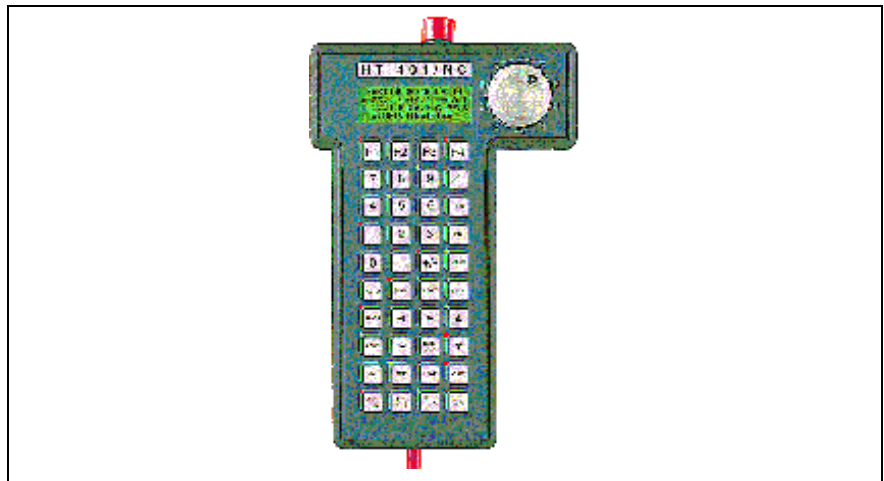


Fig. 1-3: **BTC05.1A-HN2-FW** - Additionally electronic handwheel (Numeric Control)



Fig. 1-4: **BTC05.1A-HP2-FW** - Like NC, but only 32 keys and additionally two override potentiometers.

LC-Display	4 x 20 characters
Interface	<ul style="list-style-type: none"> - RS 232C - RS 232C and RS 422A - RS 232C and RS 485
Handrad	<ul style="list-style-type: none"> - with handwheel - without handwheel
Override potentiometer	<ul style="list-style-type: none"> - with one override potentiometer - with two override potentiometers - without override potentiometer
Deadman keys	<ul style="list-style-type: none"> - 2-step, standard - 3-step (0 - 1 - 0)
Firmware	The type code can be obtained from the MT-CNC order list.

1.1 Construction of the Handheld Terminal BTC05

- CE conforming casing
- Casing form conceived for both left- and right-handers
- Impact-resistant plastic casing withstands oil, grease, alcohol, and condensates containing hydrochloric acid, nonflammability (UL94-V0)
- Rubber bushing at cable entry for cables with diameter from 8 to 11 mm.

Operating and display panel

- 40 membrane keys with tactile feedback, transparent key surface rim embossing
- 40 2-colour LEDs (red and green), assigned to each key
- 4 slots for individual key labeling
- Slot for individual device labeling (e.g. company logo)
- Buzzer installed in the back of the device for keyclick and audible alarm.
- LED-backlighting supertwist LC display with 4 x 20 or 8 x 20 characters and contrast adjustable by the software
- Emergency stop switch in accordance with EN60204-1, DIN VDE 0660 Teil 200, 207
2 potential-free break-contacts for connecting external peripherals, nominal voltage 24 V, maximum current 500 mA and 1 potential-free break-contact for internal software evaluation
- 2 deadman keys in accordance with EN775:
2 potential-free make-contacts switched in parallel for connecting external peripherals, nominal voltage 24 V, maximum current 500 mA

Hardware

- Microprocessor Hitachi H8/3002
- 256k FLASH memory
128k SRAM
- Battery-buffered real-time clock
- Interfaces, to be configured by the software:
 - Serial Interface 1:*
 - RS-232-C (without hardware handshake),
 - 20 mA Current Loop (transmitter and receiver can be configured active or passive)
 - Serial Interface 2:*
 - RS-232-C (without hardware handshake),
 - 20 mA Current Loop (transmitter and receiver can be configured active or passive)
 - RS-422-A / RS-485
- Transmission rate up to 38400 Baud
- Optical isolation of power supply
- All signals and voltages are connected to a separate connection board.

Technical Specifications

Dimensions	casing: 180 x 280 x 61 mm
Weight	approx. 1,0 kg
Display	Type: supertwist LCD
	Backlighting: LED
	Size (W x H): 76 x 25 (62 x 43) mm
	Resolution: 4 x 20 (8 x 20) characters
Protection System	IP54
Temperature range (operation)	0 °C to 45 °C
Storage temperature	0 °C to 70 °C
Relative air humidity (non condensing)	5 % to 95 %
Vibration resistance (operation)	5 g (IEC 68-2-6)
Impact resistance (operation)	50 g / 11 ms (IEC 68-2-27)
Bump resistance (operation)	25 g / 6 ms (IEC 68-2-29)
Power supply	15 V DC to 36 V DC
Current consumption	typ. 0,2 A
Basic functions	<ul style="list-style-type: none"> • power-on self-test • diagnosis program for keypad, display and serial interface • setup program
Options	<ul style="list-style-type: none"> • 2nd serial interface BTC05-COM2, • deadman keys 2- or 3-step, • electronic handwheel, • 1 or 2 override potentiometer.
Accessories	<ul style="list-style-type: none"> • hand strap, • wall holder for stationary operation or storage • software for programming and loading the BTC05, • SPS function block for driving the BTC05 via the SPS and a SPS program as an application example, • Connection cable, connector and assembling.

2 BTC05 Programming Software

2.1 Introduction

A programming software which is capable of running under MS-DOS is supplied for setting the device configuration and creating texts. This software provides functions for creating configuration data editing message text lines that are displayed in the LC-display and for loading the project. The operation of the software is menu-driven.

2.2 Hardware Specifications

For programming the device configuration, the following hardware components are required:

- BTC05 Handheld Terminal,
- PC for programming,
- 24 V DC power unit to the BTC05 power supply
- Connection cable between serial interface 1 (RS-232-C) on BTC05 and serial port COM1 or COM2 on the programming PC.

2.3 Installation under MS-DOS

The programming software for the BTC05 is delivered on a floppy disk (SWD-BTC05*-004-16VRS-DE) in packed form. The floppy disk contains the file '_HT401_.EXE'. It is recommended to create a separate directory for the software on the programming PC.

Installation instruction

- Create the installation directory BTC05 on the hard disk C of the programming PC
MD C:\BTC05
- Copy the file from floppy drive into the new directory
COPY A:_HT401_.EXE C:\BTC05
- Change directory to the installation directory
C:
CD BTC05
- When file _HT401_.EXE is executed, all files of the programming software are automatically unpacked.
- After all files have been unpacked, the file _HT401_.EXE can be deleted in the installation directory.
DEL _HT401_.EXE

2.4 Installation under MS Windows

The 3 delivered disks (SWD-BTC05*-004-16VRS-MS-WIN*NT) include the programming software for the handheld terminal BTC05. It is recommended to create a separate directory for the software on the programming PC.

Installation procedure:

Insert the first disk in your programming PC and call the automatic setup program SETUP.EXE under Windows.

The programming program (HTWIN.EXE) has been developed for "Windows NT" and "Windows 95" (32 bit operating systems) especially. If the programming software is to be used under "Windows 3.xx" or "Windows for Workgroups" (16 bit operating systems), the operating system extension Win32s (from Version V 1.3c) on must be installed. It provides the 32 bit API (Application Interface).

Limitations under Windows 3.xx and Windows for Workgroups:

Since Win32s does not support the COM-API (Communication Application Interface), the serial interface cannot be addressed.

Loading files from or to the HAT can be executed with the help of a terminal program which provides the XMODEM protocol (e. g. Windows standard terminal program TERMINAL.EXE).

2.5 Applications of the Programming Software

The program is started by calling up the file 'HT401.EXE' from the directory created above. Under MS Windows, the programming software is started by calling the HTWIN.exe file.

- Program start**
- Program call from the installation directory
HT401

The following chapters describe the programming of a handheld terminal. Not every single menu item of the programming software is described (see chapter 2.7 'Reference', page 2-12), but how to proceed when programming.

Programming example

The handheld terminal is connected to the control computer via a serial interface (COM1, RS-232-C). The transmission rate between the handheld terminal and the control computer should be 9600 Baud. The programming PC uses a serial interface (COM1). The transmission rate between the handheld terminal and the programming PC should be 38400 Baud.

2.6 Programming Software Main Menu

After starting the program, the following initial screen appears (Fig. 2-1: HT401 - Initial screen). The menu item 'Select Protocol' of the main menu is automatically opened when starting the program.

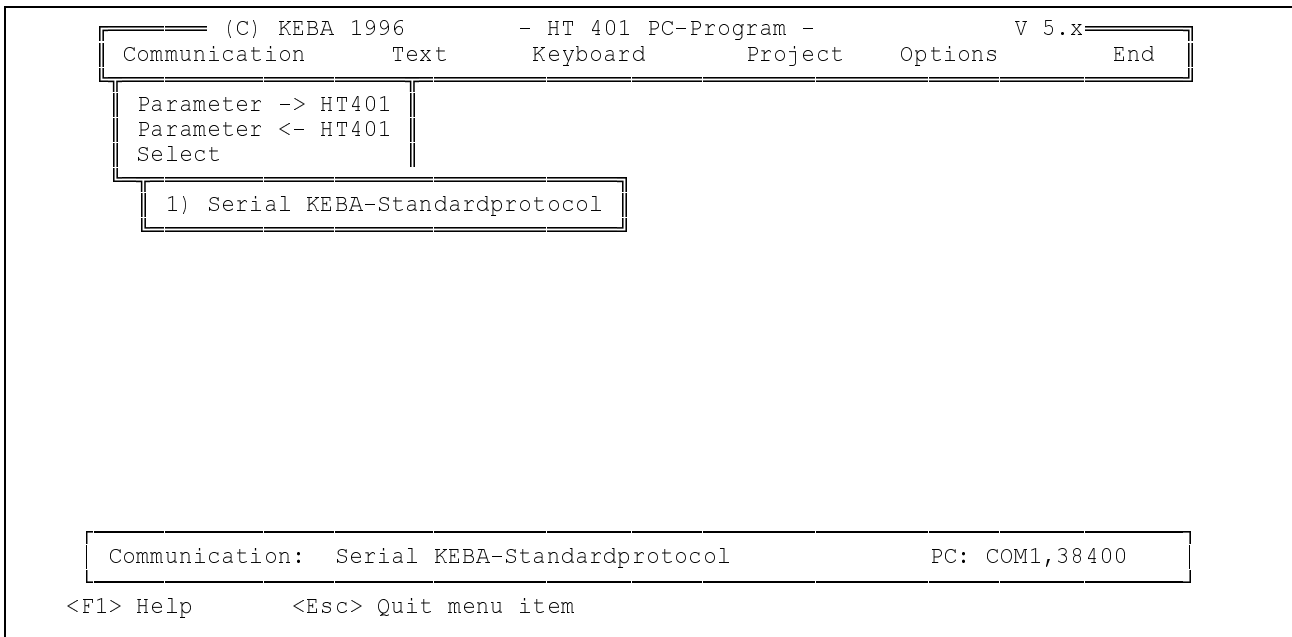


Fig. 2-1: HT401 - Initial screen

The top line of the initial screen represents the title line. It contains the handheld terminal manufacturers name, program name, and the program version.

The second line contains the main menu of the program. It consists of the following menu items:

Communication	Setting the kind of coupling (Connection between the handheld terminal and the control computer) and the related coupling parameters.
Text	Defining and editing a message text file and loading the file into the handheld terminals internal text memory.
Keyboard	Modifying the handheld terminals internal editors key assignement.
Project	Loading the selected message text file, the system program, and the coupling parameters into the handheld terminal.
Options	HT401 program colour and language setting. Programming PC interface data setting.
End	Exit the HT401 program.

The single reframed line at the bottom represents the status line. In here the selected coupling and the selected interface parameters of the programming PC are displayed.

Additional key commands are in the bottom line. These are valid in every menu item.

Communication

The coupling is set in 'Select' of the main menu item 'Communication' (see Fig. 2-1: HT401 - Initial screen). A submenu containing 'Serial KEBA-Standardprotocol' is displayed. If this coupling is selected, then additional submenus are displayed where the coupling parameters (interface configuration) can be set.

Programming example

The handheld terminal should be operated using a serial interface. Select 'Serial KEBA-Standardprotocol' from the menu item 'Communication'. A list of available interface types of the handheld terminal appears. In this example, the type COM1/RS-232-C must be set. Set the transmission rate after confirming the type (e.g. 9600 Baud). After the settings have been saved, the menu item 'Communication' can be left.

Text

The programming actually takes place in menu item 'Text'. Up to 2000 message texts with a length of 1 line (20 characters) each can be defined. These texts can be displayed initiated by the control.

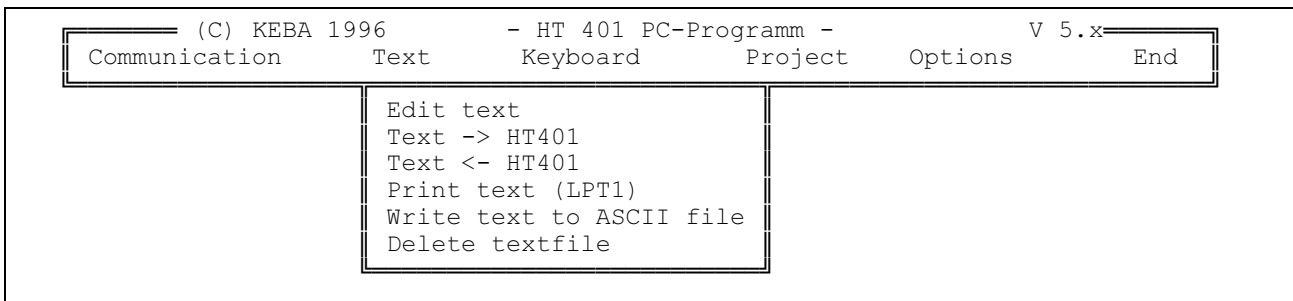


Fig. 2-2: Menu 'Text'

Using the menu item 'Edit text' existing message text files can be edited or new message text files can be created. When selecting this menu item, the following file selection window appears:

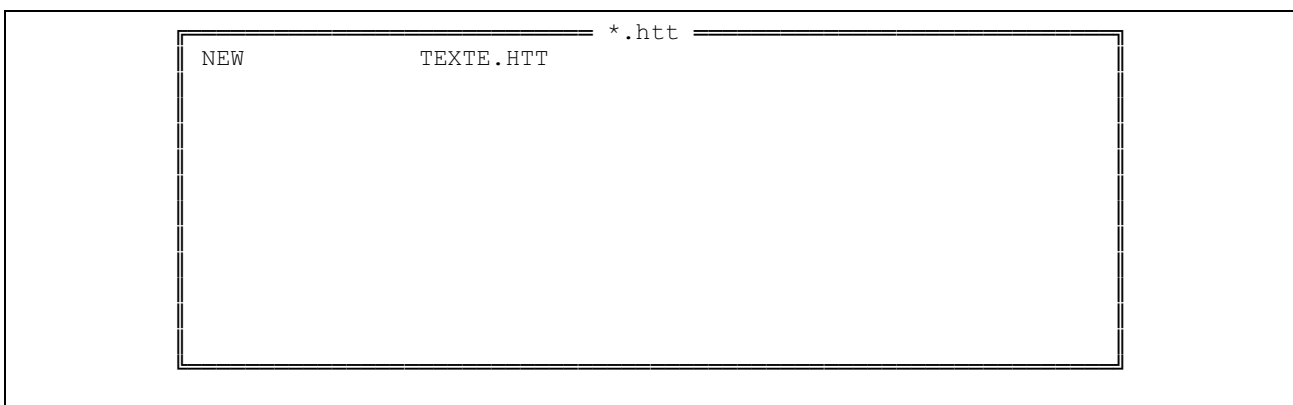


Fig. 2-3: Message text file selection window

The file TEXTE.HTT already contains predefined message texts.

If 'NEW' is selected, the selection window is closed and the file name of the message text file to be created is prompted at the status line e.g. BTC_DEMO (see Fig. 2-4: Message text file name input).

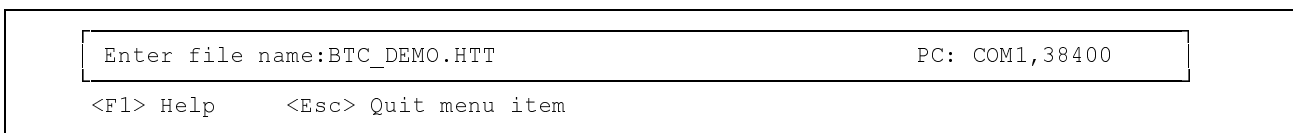


Fig. 2-4: Message text file name input

After confirming the file name, the message text editor is called (see Fig. 2-5: Message text editor containing 9 message text examples).

```

===== BTC_DEMO.HTT =====
Nr.      Text
0        INDRAMAT
1 Bgm.-Dr.-Nebel-Str.2
2  97816 Loehr am Main
3 CLS   RD   BEL   ->
4 SET   RD   EDIT  <-
5 act. wheel : #####
6 set wheel : _____
7   enter password _____
8
9
10
11
12
13
14
15
16
17
18
19
                                <pgup> <pgdn>
                                <TAB>   next variable
                                <shift><TAB> previous variable
                                <F2>   mark block start
                                <F3>   mark block end
                                <F4>   unmark block
                                <F5>   insert block
                                <F7>   insert line
                                <F8>   delete line
                                _      space for input (IN, IN/OUT)
                                #      space for output only (OUT)

<F1> Help      <Esc> Quit menu item

```

Fig. 2-5: Message text editor containing 9 message text examples

Programming example

The input of the message texts shown in Fig. 2-5: Message text editor containing 9 message text examples is performed similarly to every normal text editor. After pressing the ENTER key, the editing of the particular text line is terminated and the cursor proceeds to the next line. Message texts can be input in any sequence and at any position within the editor.

Various edit commands are available for working on the texts. These are described on the right hand side of the editor or in help.

Programming Variables in a Message Text

It is possible to display more than one variable within a message text line. The positions where the variables are displayed must be marked with placeholders for input or output fields.

- Output fields
(Variables of the IO type 'OUT') must be marked with the placeholder '#';
- Input fields
(Variables of the IO type 'IN') must be marked with the placeholder '_';

During the input or the output of a value on the LC display of the handheld terminal, the placeholders will be overwritten. During an overflow (variable value too large for displaying it in the programmed field), '*' characters will be displayed (e. g. two digit output field: ##, value to be displayed: 100, ⇒ output: **).

After entering the input and/or output fields, the variables of these fields must be defined. For this, the cursor must be positioned on the corresponding field and the TAB key must be pressed. The cursor jumps to a variable field which is displayed on the right side next to the message texts (see Fig. 2-6: Variable field). Here the number, the data type, the format and the I/O type of the variable are defined.

```

BTC_DEMO.HTT
Nr.      Text
0        INDRAMAT          Var.No: 0
1 Bgm.-Dr.-Nebel-Str.2 Data type:
2 97816 Lohr am Main      Format: DEC
3 CLS  RD  BEL  ->      I/O type:
4 SET  RD  EDIT  <-
5 act. wheel : #####
6 set wheel  : _____
7   enter password
8   _____

```

Fig. 2-6: Variable field

In the Var.Nr. line, the variable number is entered.

Allowed variable numbers

Allowed variable numbers:

100 ... 32767 for 1 / 2 / 4 byte and float (real) variables,
0 ... 255 for string variables.

After confirming the variable number with the ENTER key, a window for selecting the data type is opened (see Fig. 2-7: Data types for variables). By entering the data type the handheld terminal knows how to interpret the received or entered value.

```

+-----+
|UINT8   1 Byte           0 .. 255
|SINT8   1 Byte          -128 .. +127
|UINT16  2 Byte           0 .. +65535
|SINT16  2 Byte          -32768 .. +32767
|UINT32  4 Byte           0 .. +4294967295
|SINT32  4 Byte          -2147483648 .. +2147483647
|FLOAT32 4 Byte  -3,4 * 10^-38 .. +3,4 * 10^38
|STRING  n Byte
+-----+

```

Fig. 2-7: Data types for variables

Data types

The data types are divided in five groups:

1 / 2 / 4 byte, float and string.

Variables are distinguished by their numbers and groups (i. e. variables are only identical if they have the same variable number and if they are also in the same data type group).

By confirming the ENTER key, the selected data type will be applied. A selection table with all possible display formats is displayed on the screen:

- DEC (0-9),
- HEX (0-9, A-F),
- BCD (0-9),
- BIN (0, 1),
- TEXT and
- INVISIBLE.

By selecting TEXT, message texts within a variable field (only with I/O type 'OUT') can be displayed. The variable includes the message text number. If the entered variable value is to be displayed by '*' characters on the LC display only (e. g. password entry), the display format INVISIBLE must be selected.

Note: For STRING variable, only the display formats TEXT and INVISIBLE are allowed.

I/O Types

The display format is applied after pressing the ENTER key. A list of possible IO types is displayed on the screen.

- OUT = Output
The variable is written by the control and is displayed in the corresponding variable format on the display. The character '#' must be used for placeholder in text.

- **IN = Input**
An empty input field is displayed. If allowed keys are pressed, they are displayed one after the other on the LC display. By pressing the ENTER key, the entered key combination is evaluated and transferred to the control. The character '_' must be used for placeholder in text.
- **IN/OUT = Combination of input and output**
The variable can be written by the control and also entered by the handheld terminal and sent to the control. By confirming the ESC key the edit process can be canceled, the value in the control remains unchanged. By pressing the ENTER key, the edit process is finished and the entered value is transferred to the control. The character '_' must be used for placeholder in text.

Examples for variable fields

Variable field	Format	I/O Type	Variable value (decimal)	Display
##	DEC	OUT	99	'99'
###.## *)	DEC	OUT	100	' 1.00'
			5	' 0.05'
	DEC	OUT	-1	'-0.01'
	DEC	OUT	1.234	' 1.23'
#####			100.1	'**,**'
			-1.5	' -1.5'
#####			43.78	'43.78'
			32	00100000
#####	BIN	OUT	85	01010101
			31548	'7B3C'
#####	HEX	OUT	45054	'AFFE'

*) Fix comma for integer and float data types. Format DEC allowed only.

Fig. 2-8: Examples for variable fields

Programming example

In the message text lines 5, 6 and 8 input and/or output fields were entered. For these fields the following variables must be defined:

Zeile 5: Var.No.: 103, Data type: SINT16, Format DEC, I/O type: OUT

Zeile 6: Var.No.: 101, Data type: SINT16, Format DEC, I/O type: IN/OUT

Zeile 7: Var.No.: 102, Data type: STRING, Format INVISIBLE, I/O type: IN

After entering the I/O type it is possible to return to the message text editor by pressing the TAB key.

The ESC key exits the message text editor. The following submenu is displayed:

```
+-----+
| edit   |
| save   |
| save as... |
| close  |
+-----+
```

Fig. 2-9: Submenu 'Edit Texts'

By calling 'Edit' it is possible to edit the created message text. 'Save' or 'Save As' allows to save the message text in a file. By calling the Submenu item 'Close' the 'Text' menu is closed. If the created file has not been saved yet, you are prompted if you want to save it before you close the menu.

Keyboard

The handheld terminal has its own editor for variable value input. The input is performed by the keyboard of the handheld terminal, whose layout can be determined in this menu item.

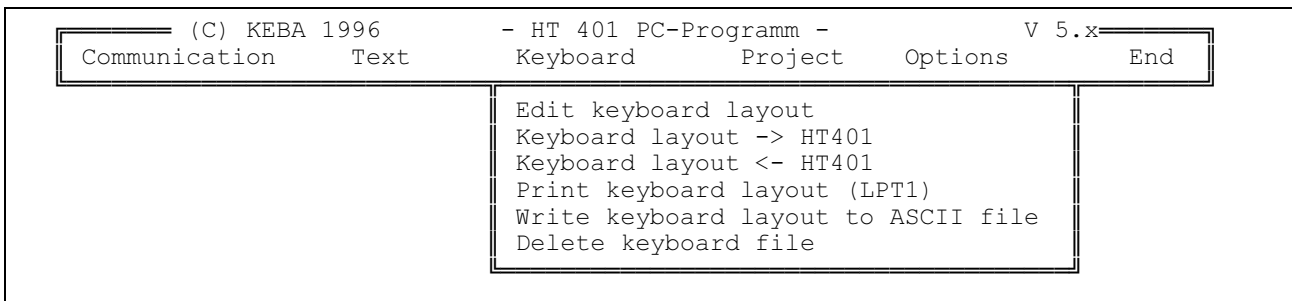


Fig. 2-10: Menu item 'Keyboard'

Through the menu item 'Keyboard', existing keyboard assignments can be modified or new assignments can be determined. When calling this menu item, a file selection window similar to that of the menu item 'Text' appears (see Fig. 2-3: Message text file selection window, filename format *.KBD).

The file KEYBOARD.KBD contains a predefined keyboard layout.

When selecting 'NEW', the selection window is closed and the filename of the new keyboard assignment file to be generated can be input at the status line, e.g. BTC_DEMO (similar to the input of a name of a message text file, see Fig. 2-4: Message text file name input).

After confirming the file name, the keyboard layout editor is called (see Fig. 2-11: Keyboard assignment editor with a keyboard assignment example).

One, two, three or four codes may be assigned to each key. Following the functioning of a PC keyboard, one of the 40 keys must be assigned as SHIFT key in case of a double assignment. If of a triple assignment, an additional CTRL key must be defined. In case four codes are assigned to one key, then an additional ALT key is required. Editing the SHIFT, CTRL and ALT keyboard assignment is possible only if a SHIFT, CTRL or ALT key was defined in the basic level.

Note: The following key combinations are allowed:

- a) up to a maximum of 8 keys simultaneously inside a group of eight keys or
- b) only one key out of each group (maximum 5) with 8 keys each.

Any other key combination cannot be evaluated correctly due to internal wiring.

```

BTC_DEMO.KBD

DEZ:    0
HEX:    00

          Shift      Ctrl      Alt
7 8 9 !1 A B C D   a b c d
4 5 6      E F G H   e f g h
1 2 3      I J K L   i j k l
0 . - !2 M N O P   m n o p
^          Q R S T   q r s t
< v >     U V W X   u v w x
S c       Y Z       y z

          1 key left
          1 key right
          1 key up
          1 key down

          <DEL>   delete key

          <Enter> select special key

          <F8>   delete keyboard layout

<F1> Help      <Esc> Quit menu item

```

Fig. 2-11: Keyboard assignment editor with a keyboard assignment example

Programmable Keys

- Shift** Selection of a character from the 2nd keyboard layout level (press simultaneously).
 - Shift Lock** Switches over to to the 2nd keyboard layout level and remains activated until the Lock key is pressed once again.
 - Ctrl** Selection of a character from the 3rd keyboard layout level (press simultaneously).
 - Ctrl Lock** Switches over to to the 3rd keyboard layout level and remains activated until the Lock key is pressed once again.
 - Alt** Selection of a character from the 4th keyboard layout level (press simultaneously).
 - Alt Lock** Switches over to to the 4th keyboard layout level and remains activated until the Lock key is pressed once again.
 - Enter** Takes over a variable entered (following that, the cursor jumps to the next input field).
 - ESC** Deletes the current entry. The old contents of the field (before the input) are displayed again.
 - Delete** Deletes a character entered
 - ←, →, ↑, ↓** Cursor control in case several input fields are available
- If the possibility of variable input is used, all required keys had been determined when programming.
- In case of 'Texts with variable input', the following keys must be defined:

Variable format:	Required keys:
Binary	0, 1, Enter, Esc
Unsigned decimal	0 ... 9, Enter, Esc
Signed decimal	0 ... 9, -, Enter, Esc
Hexadecimal	0 ... 9, A ... F Enter, Esc
BCD	0 ... 9, Enter, Esc

Key input examples

Example 1:

_ _ _ _ → '1' → _ _ _ 1 → '2' → _ _ 12 → '4' → _ 1 24 → DEL → _ _ 12 → '3' → _ 1 23 → ENTER → 1 2 3

Example 2:

_ _ _ → '7' → _ _ 7 → '8' → _ 7 8 → '9' → 7 8 9 → ESC → _ _ _

Example 3:

3 5 7 → ESC → 3 5 7 → '1' → _ _ 1 → ESC → 3 5 7 → '2' → _ _ 2 → ENTER → 2

Example 4:

4 5 6 7 8 9 → DEL → _ 4 5 6 7 8 → '8' → 4 5 6 7 8 8 → ENTER → 4 5 6 7 8 8

Programming example

Starting with the second key line, the following key assignment should be defined (see Fig. 2-11: Keyboard assignment editor with a keyboard assignment example):

Basic level: Numeral block,
 !1 = ESC key,
 !2 = ENTER key,
 <>^v = Cursor control,
 c = CTRL LOCK key.

SHIFT level: Upper case

CTRL level: Lower case

Options

Through the menu item 'Options', the colour and the language of the HT401 program can be set as well as the interface of the programming PC (menu item COM ... and Baudrate).

Programming example

In this example the interface type COM1 is set and a transmission rate of 38400 is selected.

Project

After programming at the PC is completed, the project can be uploaded into the handheld terminal.

A project contains

- the program,
- the message texts,
- the keyboard layout and
- the communication parameter.

Before uploading, the handheld terminal must be put into the loading mode. In order to do this, the top left key and the top right key of the handheld terminal must be kept pressed simultaneously until the message 'Program loader ready' appears on the LC display of the handheld terminal.

After calling the menu item 'Project → HT401' in the menu 'Project', the concerning message text file (file extension HTT) and the keyboard layout file (file extension KBD) must be selected. Subsequently the complete project is uploaded to the handheld terminal (see Fig. 2-11). If the project was transmitted successfully, the handheld terminal executes a reset and starts the cyclical execution of the user program.

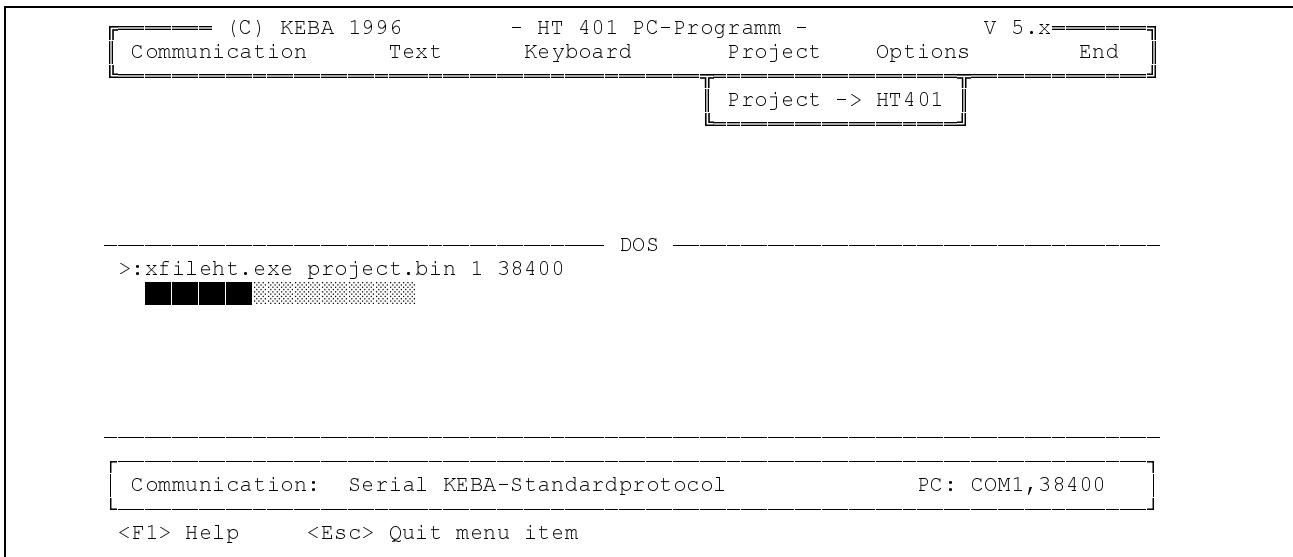


Fig. 2-12: Uploading the project into the handheld terminal

Programming example

Select the message text file BTC_DEMO.HTT and the keyboard layout file BTC_DEMO.KBD after calling the menu item 'Project → HT401'. Then the project is uploaded to the handheld terminal.

After successful transmission the HT401 program can be exit using the main menu item 'End'.

2.7 Reference

Communication

Before starting the programming, the requested coupling must be selected.

Parameter → HT401 Transmitting the communication parameter into the handheld terminal (put the BTC05 in loading mode!).

Parameter ← HT401 Reading the communication parameter stored in the handheld terminal (put the BTC05 in loading mode!).

Select Setting the communication parameter.

1) Serial KEBA-Standardprotocol

Type of protocol: Serial KEBA-Standardprotocol.

Text

Up to 2000 message texts with a length of 1 line each can be defined. After transmitting the texts into the internal memory of the handheld terminal, they can be displayed by means of the control.

Edit text The selection window appears containing already existing message text files and the menu item 'NEW'. After selecting, the text lines of the selected file can be edited and saved.

Edit Editing the selected message text file.

Save Saving the message text file.

Save as... Saving the message text file as a new filename.

Close Exit the menu item 'Text'.

Text → HT401 Write the message texts to the handheld terminal (BTC05 must be put in loading mode first!).

Text ← HT401 Reading the message texts stored in the handheld terminal (BTC05 must be put in loading mode first!).

Print text (LPT1) A selection window containing already existing message text files appears. Printing of the message text file is initiated automatically after the concerning file was selected.

Write text to ASCII file The file (.HTT) selected from the selection window will be stored as ASCII-file (.DOC). This file contains all programming data and is on disposal for e.g. documentation purposes.

Delete text file The file selected from the selection window will be deleted.

Keyboard

Edit keyboard layout The selection window appears containing already existing files and the menu item 'NEW'. After selecting, the keyboard layout can be edited and saved.

Edit Editing the selected keyboard layout file.

Save Saving the keyboard layout file.

Save as... Saving the keyboard layout file as a new filename.

Close Exit the menu 'Keyboard'.

Keyboard layout → HT401 Write the keyboard layout to the handheld terminal (BTC05 must be put in loading mode!).

Keyboard layout ← HT401 Reading the keyboard layout stored in the handheld terminal (BTC05 must be put in loading mode!).

Print keyboard layout (LPT1)	The selection window appears containing already existing keyboard layout files. Printing of the keyboard layout file is initiated automatically after the concerning file was selected.
Write keyboard layout to ASCII file	The file selected from the selection window will be stored as ASCII-file. This file contains all programming data and is on disposal for e.g. documentation purposes.
Delete keyboard layout	The file selected from the selection window will be deleted.

Project

After programming on the PC, the project can be uploaded to the handheld terminal. Before uploading, the handheld terminal must be put in loading mode ('Program loader ready').

Project → HT401	The entire project (program, texts, keyboard layout and communication parameters) are uploaded to the handheld terminal. If the project was transmitted successfully, the handheld terminal executes a reset and starts the cyclical execution of the user program.
------------------------	--

Options

Colours...	Several colour setting can be determined (e.g. window colour, menu items etc.).
Language...	The languages German and English are available.
COM...	The COM-interfaces available on the programming PC are displayed. The interface where the handheld terminal is connected to needs to be selected.
Baudrate...	Transmission rate selection: 9600, 19200 or 38400
Info	This menu item contains a brief description of 'How to create texts' and contact addresses.

End

Calling the menu item 'End' exits the program.

3 Basic Functions

3.1 Power-On Self Test

The BTC05 automatically performs a power-on self test.

If no error occurs the steps (marked by \Rightarrow) will be carried out one after the other in brief sequences.

\Rightarrow The internal buzzer of the handheld terminal triggers a short audible signal.

\Rightarrow The program is checked.
Normally the following message is displayed:

```
KEBA HT401      Vx.x
Selftest 1
Program ..... OK
x..... version of the boot software
```

The message

```
KEBA HT401      Vx.x
Selftest 1
Program .....error
```

will be displayed for 2 s if an error has been recognized in the program or if the program is not available in the handheld terminal. Then the device changes to the loading mode (the display indicates 'Program loader ready', see chapter 0 'Programm loader', page 3-6).

The following messages are only displayed in case of errors:

\Rightarrow Checking the ROM contents.

The message

```
KEBA HT401      Vx.x
Selftest 1
ROM ..... error
```

will be displayed if a ROM error has been recognized. The device remains in this error condition. A new start is only possible after turning off and on the device.

\Rightarrow Checking the FLASH type.

The message

```
KEBA HT401      Vx.x
Selftest y
Flashtyp ..... error
y..... 1 or 2
```

will be displayed if an unknown FLASH type has been entered in the configuration data. The device remains in this error condition. A new start is only possible after turning off and on the device.

\Rightarrow Checking the configuration data checksum.

The message

```
KEBA HT401      Vx.x
                Selftest y
                Configuration error
y..... 1 or 2
```

will be displayed for approx. 2 s if the checksum is not correct. The device changes to the 'Configuration Loader' mode. A new start is only possible after turning off and on the device.

⇒ Checking the keyboard matrix for pressed keys.

The message

```
KEBA HT401      Vx.x
                Selftest 2
                Keyboard ..... error
```

will be displayed if a pressed key has been found during testing. As a defect is supposed the device remains in this error condition.

⇒ After the flash memory test, the system program is invoked. What is displayed further depends on the user program.

3.2 MAIN MENU

To enter the main menu, press the keys 1 and 4 simultaneously after turning on the handheld terminal. The headline 'MAIN MENU' appears. After you release the keys, the menu itself appears.

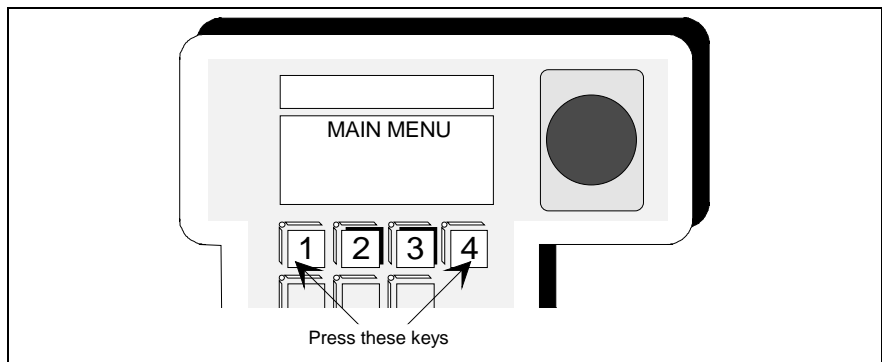


Fig. 3-1: Keys 1 and 4 after turning on the BTC05 ⇒ Main Menu

For the following menus, the keys of the first row on the handheld are available as softkeys. The last display line indicated the functions assigned to the keys of the first row.

Note: In all menus the key 1 has always the function of an ESC key.

Apart from few exceptions, the keys 2 and 3 are used to move the brackets '>' '<', that identify the menu line to be selected, up and down. The key 4 (Ok) confirms the selection.

The main menu provides the following functions:

MAIN MENU
Diagnosis
Setup
Info
System Reset

Diagnosis Menu

The diagnosis menu is a submenu of the main menu and provides different test functions:

DIAGNOSIS MENU
Keyboard Test
Battery Test
I/O Status
COM Test
LED Test
Software

Keyboard Test Tests the keyboard of the handheld terminal. All keys pressed are displayed one after the other in the line 'Pressed Key'. The 1 key acts as ESC key.

Battery Test Displays in the line 'State:' the status of the battery installed in the handheld terminal. According to the status, 'FULL' or 'EMPTY' is displayed.

I/O STATUS The following display is continuously updated:

```

I/O Status
AI1:xx Handwh.:xxxxx
AI2:xx DI:uvw Stop:x
Esc
```

Aix
A/D input (override potentiometer). The value range 0 to 63 is displayed according to the position of the override potentiometer. At devices without override potentiometer, the value displayed is of no importance.

Handwh
Count of handwheel. Each lock-in position increments or decrements the count. 100 lock-in positions =1 revolution. The counter values range from 0 to 65535.

DI
Digital inputs. Indicate the current status of the three digital inputs.

- u DI 1
- v DI 2
- w DI 3

At present, only DI 1 is used. It indicates the status of the key switch.

DI 1 = 1 not actuated

DI 1 = 0 actuated

DI 2 and DI 3 are reserve inputs.

Stop

Status of the emergency stop switch installed in the handheld terminal:

1 actuated

Esc

Back

COM Test All interfaces available in the handheld terminal can be selected for a test. They all can be tested without being connected to the control computer:

COM Test
COM1: RS-232-C
COM1: 20 mA
COM2: RS-232-C
COM2: 20mA
COM2: RS-422-A

At the interface to be tested, the transmitter and the receiver must be linked together (e.g. directly on connection board or on-site at the end of the signal lines).

The terminal and signal designations of the following table refer to the connection board:

COM1	
RS-232-C	20mA
<ul style="list-style-type: none"> ┌ 25 TXD1 └ 26 RXD1 	<ul style="list-style-type: none"> ┌ 21 TX1+ ├ 22 TX1- ├ 23 RX1+ └ 24 TX1-

COM2		
RS-232-C	20mA	RS-422-A
<ul style="list-style-type: none"> ┌ 30 TXD2 └ 31 RXD2 	<ul style="list-style-type: none"> ┌ 33 TX2+ ├ 34 TX2- ├ 35 RX2+ └ 36 RX2- 	<ul style="list-style-type: none"> ┌ 15 A ├ 14 B ├ 13 A/A' └ 12 B/B'

For the Current-Loop test, the DIP switch of the corresponding interface must be set to transmitter active and receiver passive (or vice versa).

The interface test is based on the following settings which cannot be changed by the user during the interface test:

9600 Baud, no parity, 8 databits, one stopbit.

The selected interface appears on the display:

```
COMx: y
  Transmit: z
  Receive : u
Esc
```

x..... interface 1 or 2
y..... interface type (RS-232-C, 20mA, RS-422-A)

Transmit

The BTC05 sends the ASCII characters '0' (30H) bis 'z' (7AH) one after the other at intervals of one second. The characters sent are displayed at position z.

Receive

The characters just sent are received one after the other and displayed at position u. Should the send/receive line or the interface be defective, nothing will be displayed.

- LED Test** The LEDs are flashing alternately green and red at one second intervals.
- Software** Certain warnings are logged for diagnostic purposes and assist INDRAMAT's service engineer in analysing errors. Normally the display indicates the message 'No warnings!'. The entries in this message storage are only for information. Most warnings refer to handling errors caused by the user.

Setup Menu

The setup menu is a submenu of the main menu and provides the following functions:

SETUP MENU
Date, Time
Contrast
Program Loader

- Date, Time** This function enables setting date and time of the real-time clock installed in the handheld terminal.
- Contrast** LCD contrast setting of the display.
- Program Loader** This function is used to set the parameters of the interface via which the project is loaded from the PC into the handheld terminal. These parameters are only relevant during the loading process.
The menu item does not start the loading process.
To switch the handheld terminal over to the loading mode, press and hold the keys 1 and 4 simultaneously when turning on the BTC05 until the message 'Program loader ready' appears on the display (see chapter 0 'Program loader', page 3-6).

Info Menu

The info menu is a submenu of the main menu and provides one function:

INFO MENU
Hardware

- Hardware** This menu item displays essential data of the device hardware.
- System Reset** The menu item 'System Reset' included in the main menu restarts the handheld terminal. This process corresponds to a turning on and off of the device. Pressing the keys 1 and 4 switches the device over to the loading mode.

3.3 System Errors

Fatal system errors can be caused by a defective hardware or an error in the system software (no handling error).

In case a fatal error occurs the following is displayed:

```
Error:a/b
Modul:c d.d
Line :e
Info :f
```

a..... component number
 b..... error number
 c..... module name
 d..... module revision
 e..... line number in source code
 f..... possible additional information

Note: As fatal errors are not stored in the device, please note the **complete** text displayed and contact an Rexroth Indramat service engineer.

In this condition, the handheld terminal may not even respond to incoming telegrams any more!

To change this error condition, turn the handheld terminal off and then on again.

3.4 Program loader

The programming software provides several functions for transmitting data from or to the handheld terminal.

Data transmission from or to the handheld terminal is only possible in the loading mode 'Program loader ready'. To switch the device over to this mode, press the keys 1 and 4 simultaneously while turning on the handheld terminal or during a system reset until the loading mode is indicated on the display:

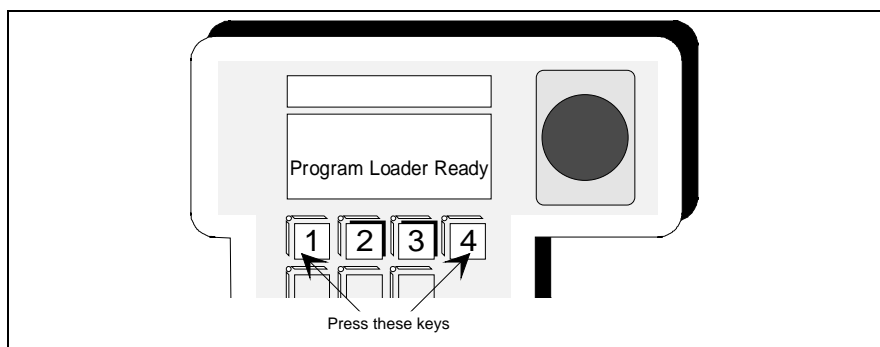


Fig. 3-2: Keys 1 and 4 pressed during while turning on: ⇒ Loading mode

The following mask is displayed:

```
KEBA HT401      Vt.t

Program loader ready
#u vvvvvv wwwww x y z
```

t..... version of boot software
 u..... number of interface port (1 or 2)
 v..... interface type (RS-232-C, RS-422-A)
 w..... baudrate
 x..... parity
 y..... data bits
 z..... stop bit

The handheld terminal is now in loading mode, and data transmission can be activated via the programming software. Depending on the transmission direction, the following is displayed:

```
KEBA HT401      Vt.t  
  
*load..... x
```

t..... version of boot software

* Down(load): PC → BTC05 or

Up(load): PC ← BTC05

x..... rotating bar during transmission or

OK when transmission has been completed successfully.

When data transmission has been successfully completed, the device performs a reset and starts the cyclic processing of the user program.

4 Control via a Serial Interface

4.1 Introduction

The handheld terminal BTC05 can be controlled by the Rexroth Indramat SPS via a serial interface. In order to support this feature, Rexroth Indramat developed the function block BTC05_3 which has the the following tasks:

- open the serial interface
- establish und monitor the data communication between the control PC and the BTC05
- evaluate the KEBA standard protocol
- close the serial interface

The function block supports a display with 8 x 20 text lines, two override potentiometers, a handwheel with absolute position value and a key matrix of 10 x 4 keys supported by a red and a green LED each.



WARNING

⇒ The function block was developed from a safety / technical point of view. Because the handheld terminal can be used for various purposes, sufficient protection of personnel and machinery is **not** guaranteed.

In addition to the hardware, the software also needs to be adapted to the safety technical requirements of the machine.

4.2 Installation

Besides the programming software, the floppy disc supplied (SWD-BTC05*-004-16VRS-DE) contains a SPS function block (Fb BTC05_3), which performs the communication between the control and the handheld terminal. It also contains a SPS demo program (PR BTC_DEMO) which shows the functionality and the application of this function block on the basis of an example.

The function block represents a special Fb (submerging into this block is not possible). It can be installed from floppy disc using the SPS user interface via the menus 'Project' - 'Archives' - 'Archive at DISC' - 'Fetch Special Fb/F/Ty'.

The installation of the sample program as well as the function block is described in the following installation instruction.

Installation instruction

The sample program PR BTC_DEMO was stored on the floppy disc supplied in the form of a project archive. In order to install this project archive, the SPS user interface needs to be called up from the MT-CNC main menu. Open the menu item 'Project' in the main menu of the SPS user interface. After selecting the submenu items 'Archives' - 'Archive at DISC' - 'Fetch Special Fb/F/Ty' sequentially, the submenu 'Fetch Special Fb/F/Ty' appears. In here the drive containing the installation disc needs to be selected. After confirming the drive, the project 'btc_demo' appears in the project window. The sample program and the function block Fb BTC05_3 are installed after confirming the project.

4.3 Calling the Function Block BTC05_3

```

          btc05
          +-----+
          |BTC05_3|
          +-----+
          |
          |  BOOL|ENABLE           ACTIVE+BOOL
          |  INT|DEVICE           ERR_FLG+BOOL
          |  INT|SERNR            ERR_NR+INT
          |  INT|BAUD             STATUS+WORD
          |  BOOL|AGREE           KEY+LED_KEY
          |  BOOL|RESET           HANDWHEEL+INT
          |  BOOL|CLRSCR          OVERRIDE1+USINT
          |  BOOL|RD_SCR          OVERRIDE1+USINT
          |  BOOL|BELL            DIG_IO+BYTE
          |  BOOL|SET_WHEEL       RD_VAR+BOOL
          |  INT|POS_WHEEL        Q_VAR+VARIABLE
          |  LED_KEY|RLED_ON      COM_+COM
          |  LED_KEY|GLED_ON
          |  LED_KEY|RLED_FL
          |  LED_KEY|GLED_FL
          |  MESSAGE|WR_MSG
          |  BOOL|EDIT_MODE
          |  VARIABLE|I_VAR
          |  SPS_TXT|WR_TEXT
          |  WORD|SETUP
          |
          +-----+

```

ENABLE:	BOOL;	enable input
DEVICE:	INT;	IO-device number
SERNR:	INT;	serial interface number
BAUD:	INT;	baudrate
AGREE:	BOOL;	agree input
RESET:	BOOL;	error acknowledge
CLRSCR:	BOOL;	rising edge: clear LC display
RD_SCR:	BOOL;	rising edge: redraw LC display
BELL:	BOOL;	buzzer on
SET_WHEEL:	BOOL;	rising edge: set handwheel absolute position
POS_WHEEL:	INT;	handwheel absolute position (command value)
RLED_ON:	LED_KEY;	red LED on
GLED_ON:	LED_KEY;	green LED on
RLED_FL:	LED_KEY;	red LED flashing mode
GLED_FL:	LED_KEY;	green LED flashing mode
WR_MSG:	MESSAGE;	output message
EDIT_MODE:	BOOL;	edit mode on
I_VAR:	VARIABLE;	send variable to handheld terminal
WR_TEXT:	SPS_TXT;	SPS text output
SETUP:	WORD;	basic setting handheld terminal
ACTIVE:	BOOL;	0 - no data communication between control and handheld terminal 1 - data communication between control and handheld terminal without error
ERR_FLG:	BOOL;	error flag
ERR_NR:	INT;	error number
STATUS:	WORD;	communication status
KEY:	LED_KEY;	key status

HANDWHEEL:	INT;	absolute handwheel position status
OVERRIDE1:	USINT;	status override 1
OVERRIDE2:	USINT;	status override 2
DIG_IO:	BYTE;	status digital I/O
RD_VAR:	BOOL;	0 - no variable received from handheld terminal 1 - variable received from handheld terminal data available at output Q_VAR
Q_VAR:	VARIABLE;	status variable from handheld terminal
COM_:	COM;	active interface data

Used Data Types

LED- and key matrix	LED_KEY	ARRAY [	0 ... 9	
		0 ... 3		
		] OF	BOOL	LED-/field of keys
SPS texts	SPS_LINE	STRUCT		
	text	TEXT	STRING[20]	text string
		COLUMN	INT	position of SPS
		END		
	SPS_TXT	ARRAY [	0 ... 7	
		] OF	SPS_LINE	SPS text
message texts	MESSAGE	ARRAY	0 ... 7	
		] OF	INT	no.of message text
variable	VARIABLE	STRUCT		
		VAR	INT	Variable number
		TYP	INT	Variable type
		REQUEST	BOOL	Variable requested
		BYTE_	BYTE	value of BYTE variable
		WORD_	WORD	value of WORD variable
		DWORD_	DWORD	value of DWORD/ REAL variable
		STRING_	STRING[20]	value of a STRING- variable
		END		

4.4 Description of the Function Block BTC05_3

ENABLE

ENABLE represents the enable input. If this input becomes a logical one, then the relevant serial interface is opened and the communication to the handheld terminal is set up. After the SETUP byte is transmitted and its feedback received, the output ACTIVE becomes logical one and communications is established.

If the enable input becomes logical zero, communications between the control and the handheld terminal will be interrupted, all outputs of the FB will be reset or set to zero (exception: output COM_) and the serial interface is closed.

Before disconnecting the handheld terminal from the serial interface, the enable input should be set to logical zero as otherwise the function block will generate an error. This error must be acknowledged via the RESET input.

A change of interface data (DEVICE, SERNR, BAUD) or of the SETUP bytes becomes valid only if the ENABLE input was logical zero after the modification took place.

DEVICE, SERNR, BAUD

The parameters of the serial interface to which the handheld terminal is connected are set on the basis of the three inputs DEVICE, SERNR and BAUD. The parameters values can be obtained from the manual SPS-Befehlssatz, chapter 'Function Blocks for Serial Interfaces' (109-0668-4189-xx/xx.xx).

Note: In order to ensure a data communication without error between the control and the handheld terminal, a transmission rate of 9600 baud (BAUD=17) is recommended.

AGREE

AGREE represents the agree input. If this input becomes logical zero, the output ACTIVE remains a logical one. The communication between the control and the handheld terminal is maintained (no 'communication timeout'). In this status, the key status (KEY), the variable status (Q_VAR) and the status of the digital I/O (DIG_IO) will be deleted. The status of the overrides (OVERRIDE1 and OVERRIDE2) as well as the status of the handwheel are frozen. The handheld terminals internal editor is deactivated.

If the agree input becomes logical one again, the frozen handwheel position is maintained even if the handwheel had been moved during the frozen status (see also page 4-5). Depending on the input EDIT_MODE, the internal editor is reactivated.

In contrast to the handwheel position, a change in the override values performed during the frozen status becomes effective immediately after the agree input becomes a logical one again.



WARNING

⇒ It is important to check the position of the override potentiometer prior to set the agree input. A velocity jump of axes movement may be caused by a sudden change of the override potentiometer.

The wiring of the LEDs and a change of the handheld terminals screen contents is depending on the agree input.

RESET

If an error occurs while establishing the communications or while communicating, all FB outputs are reset or set to zero (exception: output COM_) and the serial interface is closed. Reinitiating communication becomes possible only after the error was acknowledged by the reset input.

CLRSCR (clear screen)

If the output ACTIVE is logical one and a positive edge is recognized at the CLRSCR input, the command to clear the screen contents is transmitted to the handheld terminal.

RD_SCR (redraw screen)

If the output ACTIVE is a logical one and a positive edge is recognized at the input RD_SCR, the screen contents of the handheld terminal are deleted and a new screen is built up with messages and SPS texts that are applied to the function block.

SET_WHEEL, POS_WHEEL (set absolute handwheel position)

If the output ACTIVE is logical one and a positive edge is recognized at the input SET_WHEEL, the value momentarily applied to the input POS_WHEEL is transmitted to the handheld terminal representing the new absolute handwheel position.

The value range of the input POS_WHEEL is -32768 to +32764. The position value is processed in a grid of four. Therefore the input value should be a multiple of four. If this is not the case, the value applied to the function block will be rounded down to the next multiple of four.



WARNING

⇒ The absolute handwheel position can be set independently from the input AGREE. Changing the position value while the agree input at logical zero may cause an axis movement after setting this input back to a logical one.

If the inputs AGREE and SET_WHEEL recognize a positive edge at the same time, the value of POS_WHEEL is accepted as the new absolute position of the handwheel.

BELL (activate bell)

If this input becomes logical one, a beep is generated independently from the status of the agree input. If a pulse is applied to this input, the beep duration is about 320 ms.

RLED_ON, GLED_ON, RLED_FL, GLED_FL

The handheld terminal's red and green LEDs can be controlled in a way, that they either glow continuously (RLED_ON = red LED continuous mode, GLED_ON = green LED continuous mode) or they flash (RLED_FL = red LED flashing mode, GLED_FL = green LED flashing mode). In case both modes are applied to a LED at the same time, the flashing mode will be active. The flashing frequency is 2 Hz.

The data type of the four FB inputs is a two-dimensional array that corresponds to the handheld terminal's LED matrix. In that way it is possible to control multiple LEDs simultaneously. If the output ACTIVE is logical one and a change of the array is recognized at a FB input, the array is transmitted to the handheld terminal.

WR_MSG

The programming software makes it possible to define and store up to 2000 message texts (from 0 to 1999) on the handheld terminal's internal text memory. The control calls the message texts from the text memory by the message number. The data type to be applied to this input is an array of 8 elements containing the message numbers. Each element addresses a line of the LC display (display top line = field index 0). A message output takes place after a message number is changed and the output ACTIVE is a logical one.

Note: The function blocks internal data field which manages the message numbers, is filled with zeros when the SPS is initiated. If the contents of this data field is not overwritten by the data field applied to the input WR_MSG, the message text with the number '0' will be displayed in every line of the display after the communication between the control and the handheld terminal was established.

If no message text is to be displayed in certain lines, message text number '-1' must be input.

EDIT_MODE

With the help of the programming software, variables of the I/O type IN or IN/OUT can be defined in message texts. The value of these variables can be modified by the internal editor of the handheld terminal. The internal editor can be activated by the input EDIT_MODE (only if the agree input is also logical one). The editor is active as soon as a blinking cursor becomes visible on the LC display.

I_VAR

Variables of the IO type OUT resp. IN/OUT can be written by the control if they are displayed on the handheld terminals LC display. The handheld terminal differentiates the variables by their number and type, i.e. the value of a variable can only be displayed, if the variable in the handheld terminal and the variable sent by the control do have the same number and type.

The data type, that must be applied to the input I_VAR contains all elements necessary in order to transmit a variable to the handheld terminal. A transmission to the handheld terminal takes place, if a change of the value in the data structur of the input is recognized.

The following inputs are admissible for the concerning elements of the data type:

Variable number	VAR	100 ... 32767 0 ... 255	for BYTE, WORD, DWORD, REAL for STRING
Variable type	TYP	1	for 1 byte variable (element BYTE_ = UINT8, SINT8)
		2	for 2 byte variable (element WORD_ = UINT16, SINT16)
		3	for 4 byte variable (element DWORD_ = UINT32, SINT32)
		10	for FLOAT variable (REAL) (element DWORD_)
		12	for STRING variable (element STRING_)
Request	REQUEST	FALSE/TRUE	only used for output Q_VAR
Variable value	BYTE_	no limit	
	WORD_	no limit	
	DWORD_	no limit	
	STRING_	20 characters maximum	

Note: If a field element is not within the admissible range, the data applied are ignored. In that case there is **no** transmission to the handheld terminal.

WR_TEXT

Texts (SPS texts) generated by the control can be displayed on handheld terminal. The data type to be applied to the input is an 8-element data field (array). The field elements represent a structure consisting of a text string (TEXT) and an INTEGER numbers (COLUMN). Each element addresses a line of the LC display (display top line = field index 0). A maximum number of 20 characters defined by the text string of the field element can be displayed in a line. The text can be shifted by number given to the INTEGER number COLUMN. The texts will be displayed according to the sequence they have been changed. The existing line contents will not be deleted but overwritten by the text strings defined. Text output only takes place in case the output ACTIVE is a logical one.

SETUP

On the basis of the SETUP word, basic settings can be performed for the handheld terminal. SETUP modifications become valid only after the enable input ENABLE was logical zero.

Assignmentment SETUP word

- Bit 0: not used
- Bit 1: output the handwheels absolute value
- Bit 2: output the value of override 1
- Bit 3: output the value of override 2
- Bit 4: output digital I/Os
- Bit 5: not used
- Bit 6: not used
- Bit 7: not used

- Bit 8: not used
- Bit 9: not used
- Bit 10: handheld terminal error message, if the variable is not displayed on the LC display (see page 4-12).
- Bit 11: handheld terminal requests a variable value, provided that a variable of the IO type OUT resp. on the LC display (see page 4-12).
- Bit 12: activates tone output when releasing a key of the handheld terminal
- Bit 13: activates tone output when releasing a key of the handheld terminal
- Bit 14: lock MAIN MENU call by key combination
- Bit 15: deactivate timeout message of the handheld terminal
Timeout activation after 2 s.

Note: Calling the MAIN MENU causes a communication stopping between the control and the handheld terminal.

ACTIVE

As long as the output ACTIVE remains a logical one, the communication between the control and the handheld terminal remains active. In this status the handheld terminal can be influenced by the FB inputs. In order to evaluate the FB outputs, the AGREE input must also be logical one.

If the output ACTIVE becomes logical zero, the outputs KEY, HANDWHEEL, OVERRIDE1, OVERRIDE2 and DIG_IO are also set to zero.

ERR_FLG, ERR_NR

The output ERR_FLG displays an error between the control and the handheld terminal. Such an error must be acknowledged through the RESET input. The error to be fixed is described by the error number ERR_NR (see 4.6 Error Handling, page 4-14).

STATUS

The STATUS output word describes the communication status between the control and the handheld terminal.

As long as the STATUS word is zero, the control receives data from the handheld terminal. A complete, faultless telegram was received, if the STATUS word becomes unequal zero. The current status of the handheld terminal (key status, handwheel value, override position etc.) is located at the function blocks outputs, if the ACTIVE output and the AGREE input are logical one. A new command is sent from the control to the handheld terminal within the same SPS cycle (command transmission sequence, see chapter 0 Priorities, page 4-13). In the STATUS word, there is one bit reserved for each command.

STATUS-word assignment	Bit 0:	RESET command
	Bit 1:	SETUP command
	Bit 2:	WAIT command (command to maintain the cyclic communication),
	Bit 3:	SET_WHEEL command
	Bit 4:	BELL command
	Bit 5:	CLRSCR command
	Bit 6:	EDIT_MODE command
	Bit 7:	not used
	Bit 8:	RLED_ON command
	Bit 9:	GLED_ON command
	Bit 10:	RLED_FLA command
	Bit 11:	GLED_FLA command
	Bit 12:	WR_MSG command
	Bit 13:	I_VAR command
	Bit 14:	WR_TEXT command (see page 4-10),
Bit 15:	not used	

The STATUS word can be used in order to check and control the transmission sequence of the commands sent from the control to the handheld terminal. If for example variables are to be sent to the handheld terminal within the shortest period of time, it can be made out by bit 13 of the STATUS word, at what time the variable applied to the I_VAR input was sent to the handheld terminal. It is possible to apply the next variable to the I_VAR input already in the next SPS cycle. In case no input of higher priority has changed at the function block (see chapter 0 Priorities, page 4-13), this variable will be sent to the handheld terminal with the next command.

In order to maintain the cyclic communication between the control and the handheld terminal, the WAIT command is sent to the handheld terminal if no other command is to be sent.

Note: The data applied to the function block inputs can be sent to the handheld terminal by a command, except the WR_TEXT input. In case of WR_TEXT input, only one modified field element can be sent to the handheld terminal at a time (see chapter WR_TEXT, page 4-8), i.e. if e.g. four field elements are modified at a time, four commands must be sent to the handheld terminal.

KEY

As long as the ACTIVE output and the AGREE input are logical one, the KEY output provides the current key status. In every other case, the key status will be deleted. The data type of the KEY output is a two-dimensional data field (array) which corresponds to the key matrix of the handheld terminal.

HANDWHEEL, OVERRIDE1, OVERRIDE2

The HANDWHEEL output provides the current absolute handwheel position. As long as the ACTIVE output and the AGREE input are a logical one, the outputs OVERRIDE1 and OVERRIDE2 provide the values of the override potentiometers on the LC display (see chapter AGREE, page 4-4)

The output can be prevented by the SETUP word. In this case the value 0 is output at the relevant output.

The value range of the HANDWHEEL input is -32768 to +32764, the value range of the override outputs 0 to 252. The values of the three outputs vary in a grid of four.

Note: The status of the handwheel and of the override potentiometers is also displayed in the handheld terminals MAIN MENU. For compatibility reasons, these status values do not correspond to the values output by the function block. For that reason, e.g. the firmware function HNDWHEEL can be used for the handwheel.

DIG_IO

As long as the ACTIVE output and the AGREE input are logical one, the status of the digital inputs and the emergency stop are displayed bei the DIG_IO output. Otherwise the status is deleted.

DIG_IO byte assignement	Bit 0: key switch
	Bit 1: not used (status: logical one)
	Bit 2: not used (status: logical one)
	Bit 3: not used (status: logical zero)
	Bit 4: not used (status: logical zero)
	Bit 5: not used (status: logical zero)
	Bit 6: not used (status: logical zero)
	Bit 7: emergency stop

RD_VAR

The output RD_VAR becomes logical one, if a variable or a variable request was sent by the handheld terminal.

Q_VAR

If the value of a variable is modified using the handheld terminals internal editor and confirmed by pressing the ENTER key, then this variable value appears at the function block output Q_VAR, provided that the ACTIVE output and the AGREE input are logical one.

This output is updated with each telegram sent by the handheld terminal (STATUS output not equal 0). The output is reset if the telegram does not contain a variable or a variable request. The output type is a structure containing the variable number, type and value (for data type details see page 4-7).

If bit 11 of the STATUS word is set, the handheld terminal requests a variable value from the control, as long as a variable of the IO type OUT resp. IN/OUT is displayed on the LC display. In this case the Q_VAR outputs structure element REQUEST becomes logical one. The structure elements VAR and TYP contain the variable number and the variable type of the requested variable.

If bit 10 of the SETUP word is set, the handheld terminal returns an error message if a variable which then is not displayed on the LC display is sent by the control (from Fb input I_VAR). The error message is represented by the variable number VAR = 2, type = 3 and a variable value DWORD_ encoded as follows (see Fig. 4-1: Error message variable encoding). Variable type

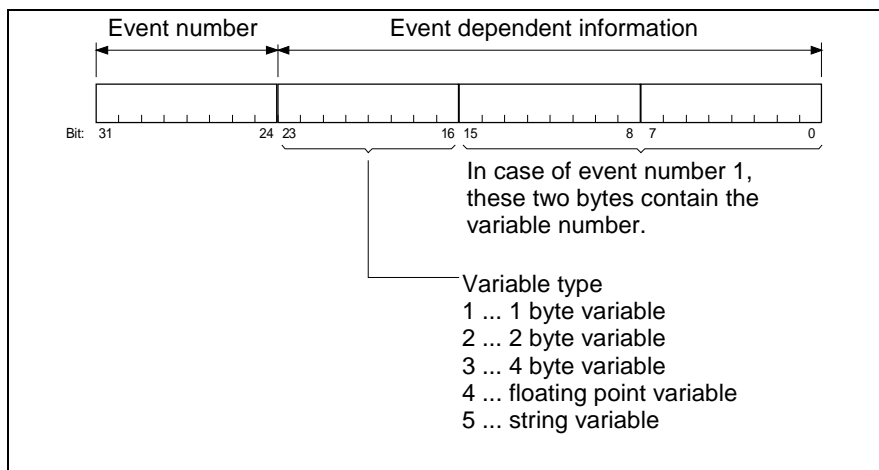


Fig. 4-1: Error message variable encoding

Note: If a variable with an inadmissible number or inadmissible type is applied to the I_VAR input, then this variable will be ignored, i.e., not sent to the handheld terminal. For this reason no error message is output (see page 4-7).

The event number is 1. This means that this event message is triggered if the control transmits a variable (variable number ≥ 100) to be displayed to the handheld terminal although no output field for this variable exists in the current text mask.

COM_

The output COM_ consists of the data type COM. It provides the current interface data.

4.5 Priorities

Transmission of modifications applied to the Fb inputs cannot take place simultaneously. Transmitting the data in the same sequence in which it

was changed does not make sense, as, for example updating the handwheel value is more important than outputting text on the screen. For this reason, the transmission is priority controlled as follows:

1. edit mode on/off
2. write handwheel position
3. tone on
4. red LED
5. green LED
6. red LED flashing
7. green LED flashing
8. clear screen
9. predefined message (WR_MSG)
10. send variable (I_VAR)
11. SPS text (WR_TEXT)
12. WAIT command

**WARNING**

⇒ The disadvantage of priority control is that if an input with high priority is regularly changed, then the changing of an input with low priority cannot be taken into account.

4.6 Error Handling

If an error occurs while establishing the communications or while communicating, all FB outputs are reset or set to zero (exception: output COM_) and the serial interface is closed. The function block generates an error described by the error number ERR_NR.

ERR_NR	Description	Error location
0	no error detected	
1	STX was not sent	Data transmission from control computer to handheld terminal erroneous!
2	command was not sent	
3	data byte 1 was not sent	
4	data byte 2 was not sent	
5	data byte 3 was not sent	
6	data byte 4 was not sent	
7	data byte 5 was not sent	
8	data byte 6 was not sent	
9	data byte 7 was not sent	
10	data byte 8 was not sent	
11	data byte 9 was not sent	
12	data byte 10 was not sent	
13	data byte 11 was not sent	
14	data byte 12 was not sent	
15	data byte 13 was not sent	
16	data byte 14 was not sent	
17	data byte 15 was not sent	
18	data byte 16 was not sent	
19	data byte 17 was not sent	
20	data byte 18 was not sent	
21	data byte 19 was not sent	
22	data byte 20 was not sent	
23	data byte 21 was not sent	
24	data byte 22 was not sent	
25	ETX was not sent	
26	BCC was not sent	
30	incomplete acknowledge telegram received	Data transmission from handheld terminal to control computer erroneous!
31	no STX received	
32	erroneous identifier of the BTC acknowledge telegram	
33	no ETX received	
34	no ACK received	
35	data input checksum incorrect	
36	erroneous variable type received	
37	erroneous variable string length received	

ERR_NR	Description	Error location
40	serial interface could not be opened	Error during communication setup
41	RESET command could not be sent	
42	ACK was not received after RESET command	
43	EOT was not received after RESET command	
44	SETUP command could not be sent	
45	ACK was not received after SETUP command	
46	erroneous device identifier (NO INDRAMAT LICENCE)	
47	serial interface could not be closed	... communication termination

If the error number ERR_NR ranges between 40 and 47, then the interface parameter of the handheld terminal and the function block should be checked. The hardware connection between the control computer and the handheld terminal can be a further source of error.

In case of error number 46, the handheld terminal is not supported by the function block.

Please contact Rexroth Indramat service.

4.7 Application example

Three different menus are displayed on the LC display. These menus are generated by calling message texts from the handheld terminal's internal text memory. The texts have been drawn up as described in the chapter 'Application of the Programming Software' (page 2-2). Prior to testing, these message texts must be transmitted into the handheld terminal.

A password request with the help of a variable is implemented in the first menu. The password is '123'. After the password was entered correctly, the second menu appears. A rotating SPS text is displayed on the top line. The bottom line contains a menu which is operated by the keys in the first line.

```
CLS      clear screen
RD       refresh display
BEL      buzzer on
→       switch to menu 3
```

By calling the menu item 'switch to menu 3', the third menu is displayed. The current handwheel value is displayed in the top line. A new handwheel value can be input to the second line with the help of the internal editor. The bottom line again contains a menu.

```
SET      set the handwheel value to value displayed in the second line
RD       refresh display
EDIT     Edit mode on/off
←       switch to menu 2
```

The interface data (DEVICE, SERNR and BAUD) applied to a function block need to be checked prior to starting the program.

The floppy disc supplied contains this application example in the project archive 'DEMO'.

```

(*connecting the handheld terminal to the control; baudrate = 9600 Baud*)
btc05
+-----+
|BTC05_3|
+-----+
|ENABLE| ACTIVE+-----| active
|0-| DEVICE| ERR_FLG+-----| ( )
|3-| SERNR| ERR_NR+-err_nr| err_flg
|17-| BAUD| STATUS+-status| ( )
+-----+
|AGREE| KEY+-key
+-----+
|RESET| HANDWHEEL+-handwheel
|key[0,0] menue
+| +-----|/+-----| CLRSCR| OVERRIDE1+
|key[0,0] menue
+| +-----| +-----| RD_SCR| OVERRIDE2+
|key[0,1]
+| +-----+
|key[0,3]
+| +-----+
|key[0,2] menue
+| +-----|/+-----| BELL| Q_VAR+-q_var
|key[0,0] menue
+| +-----| +-----| SET_WHEEL| COM_+-com_
| pos_wheel-| POS_WHEEL
| rled_on-| RLED_ON
| | GLED_ON
| | RLED_FL
| gled_flg-| GLED_FL
| wr_msg-| WR_MSG
|edit_mode
+| +-----+
|password |
+|/+-----+
| i_var-| I_VAR
| wr text-| WR_TEXT
| <000011110-| SETUP
+-----+
btc05..... FB: coupling of the BTC05..... BTC05_3
active..... BTC05 active..... BOOL
0..... ANY_INT
err_flg..... error flag..... BOOL
3..... ANY_INT
err_nr..... error number..... INT
17..... ANY_INT
status..... communication status of the BTC05..... WORD
key..... keys..... LED_KEY
handwheel..... absolute handwheel position..... INT
key[0,0]..... BOOL
menue..... menu 2..... BOOL
key[0,0]..... BOOL
menue..... menu 2..... BOOL
key[0,1]..... BOOL
key[0,3]..... BOOL
rd_var..... variable applied to FB output..... BOOL
key[0,2]..... menu 2..... BOOL
q_var..... variable received from BTC05..... VARIABLE
key[0,0]..... BOOL
menue..... menu 2..... BOOL
com_..... actual interface data..... COM
pos_wheel..... handwheel position..... INT
rled_on..... red LEDs..... LED_KEY
gled_flg..... green LEDs..... LED_KEY

```

```

wr_msg..... message numbers..... MESSAGE
edit_mode..... edit variable..... BOOL
password..... password entered..... BOOL
i_var..... variable send to BTC05..... VARIABLE
wr_text..... SPS texts..... SPS_TXT
2#11001100000111110... .. Binary

|(*PASSWORD ENTRY*)
|(*delete password, if handheld terminal not active*)
|active..... password
+|/+----- (R)-----
active..... BTC05 active..... BOOL
password..... password entered..... BOOL

|(*menu enable, if password o.k.*)
|password
+| +----->>M1_BEG
password..... password entered..... BOOL
M1_BEG..... LABEL

|(*clear LEDs of handheld terminal*)
|
|      +-----+
|      |:=|
|del_led-|      +-rled_on
|      +-----+
del_led..... cleared LED matrix..... LED_KEY
rled_on..... red LEDs..... LED_KEY

|
|      +-----+
|      |:=|
|del_led-|      +-gled_fl
|      +-----+
del_led..... cleared LED matrix..... LED_KEY
gled_fl..... green LEDs..... LED_KEY

|(*clear SPS texts*)
|
|      +-----+
|      |:=|
|del_text-|      +-wr_text
|      +-----+
del_text..... cleared SPS text field..... SPS_TXT
wr_text..... SPS texts..... SPS_TXT

|(*prepare LC display for password entry*)
|(*text line 1: '   INDRAMAT'*)
|
|      +-----+
|      |:=|
|      0-|      +-wr_msg[0]
|      +-----+
0..... ANY_INT
wr_msg[0]..... INT

|(*text line 2: '   enter password'*)
|
|      +-----+
|      |:=|
|      7-|      +-wr_msg[1]
|      +-----+
7..... ANY_INT
wr_msg[1]..... INT

|(*text line 3: '   _____'; password variable*)
|
|      +-----+
|      |:=|
|      8-|      +-wr_msg[2]
|      +-----+
8..... ANY_INT
wr_msg[2]..... INT

```

```

|(*text line 4: '      INDRAMAT'*)
|
|      +-----+
|      :=      |
|0-|      +-wr_msg[3]
|      +-----+
0..... ANY_INT
wr_msg[3]..... INT

|(*password check*)
|
|      +-----+
|      :=      |
|<r.STRING -|      +----- password
|< 123^-|      +----- ( )-----
|      +-----+
q_var.STRING_..... value of STRING[20] variable..... STRING[20]
password..... password entered..... BOOL
' 123'..... STRING[10]

+----->>ENDE
ENDE..... LABEL

|(*function block to toggle between two menus*)
|M1_BEG:  fb_menue
|
|      +-----+
|      |TOGGLE|
|-----+----- menue
+----- ENABL      Q_+----- ( )-----
|key[0,3]|
+| +-----| IN
|active|
+|/+-----| RESET
|      +-----+
fb_menue..... FB: Toggle between two menus..... TOGGLE
menue..... menu 2..... BOOL
key[0,3]..... BOOL
active..... BTC05 active..... BOOL

|(*jump to menu 2*)
|menue
+| +----->>MEN2
menue..... menu 2..... BOOL
MEN2..... LABEL

|(*MENU 1*)
|(*assigning key presses to red LEDs*)
|
|      +-----+
|      :=      |
|      key-|      +-rled_on
|      +-----+
key..... keys..... LED_KEY
rled_on..... red LEDs..... LED_KEY

|(*clear green LEDs of handheld terminal*)
|
|      +-----+
|      :=      |
|      del_led-|      +-gled_fl
|      +-----+
del_led..... cleared LED matrix..... LED_KEY
gled_fl..... green LEDs..... LED_KEY

|(*setting of message text numbers*)
|(*text line 1: '      INDRAMAT'*)
|
|      +-----+
|      :=      |
|0-|      +-wr_msg[0]
|      +-----+
0..... ANY_INT
wr_msg[0]..... INT

```

```

|(*text line 2: 'Bgm.-Dr.-Nebel-Str.2'*)
|-----+
|:=|
|1-|      +-wr_msg[1]
|-----+
1..... ANY_INT
wr_msg[1]..... INT

```

```

|(*text line 3: ' 97816 Lohr am Main'*)
|-----+
|:=|
|2-|      +-wr_msg[2]
|-----+
2..... ANY_INT
wr_msg[2]..... INT

```

```

|(*text line 4: 'CLS  RD  BEL  -> '*)
|-----+
|:=|
|3-|      +-wr_msg[3]
|-----+
3..... ANY_INT
wr_msg[3]..... INT

```

```

|-----+
|<>|
|status-|----->>ENDE
|16#0004-|
|-----+
status..... communication status of the BTC05..... WORD
ENDE..... LABEL
16#0004..... Hexadec

```

```

|(*calculation of the new text string for text line 1*)
|-----+
|+|
|count-|      +-count
|1-|      |
|-----+
count..... position of the String..... INT
count..... position of the String..... INT
1..... ANY_INT

```

```

|-----+
|<=|
|count-|----->>M1_END
|27-|      |
|-----+
count..... position of the String..... INT
M1_END..... LABEL
27..... ANY_INT

```

```

|-----+
|:=|
|1-|      +-count
|-----+
1..... ANY_INT
count..... position of the String..... INT

```

```

|(*setting of SPS texts*)
|M1_END:
|(*SPS text string '      INDRAMAT      '*)
|-----+
|:=|
|«  '-|      +-string
|-----+
|      INDRAMAT ..... STRING[48]

```

```

string..... SPS text string..... STRING

(*text line 1: moving INDRAMAT logo generated from SPS text string*)
+-----+
|MID
string-|IN_ +-«t[0].TEXT
 20-|L_
count-|P_
+-----+
string..... SPS text string..... STRING
MID..... MID
wr_text[0].TEXT..... SPS text..... STRING[20]
20..... ANY_INT
count..... position of the String..... INT

+-----+
|:=
0-| +-«0].COLUMN
+-----+
0..... ANY_INT
wr_text[0].COLUMN.... position of the SPS text..... INT

+-----+>>ENDE
ENDE..... LABEL

(*MENU 2*)
(*assigning key presses to the green LEDs*)
MEN2: +-----+
      |:=
      key-| +-gled_fl
      +-----+
key..... keys..... LED_KEY
gled_fl..... green LEDs..... LED_KEY

(*clear red LEDs of the handheld terminal*)
+-----+
|:=
del_led-| +-rled_on
+-----+
del_led..... cleared LED matrix..... LED_KEY
rled_on..... red LEDs..... LED_KEY

(*clear SPS text of 1st text line*)
+-----+
|:=
''-| +-«t[0].TEXT
+-----+
''..... STRING[0]
wr_text[0].TEXT..... SPS text..... STRING[20]

(*setting of message text number*)
(*text line 1: 'act. wheel :'*)
+-----+
|:=
5-| +-wr_msg[0]
+-----+
5..... ANY_INT
wr_msg[0]..... INT

(*text line 2: 'set wheel :'*)
+-----+
|:=
6-| +-wr_msg[1]
+-----+
6..... ANY_INT
wr_msg[1]..... INT

```


5 Labeling

As different functions can be assigned to the keys of the BTC05, there is the possibility of labeling the operator panel to your specific requirements. Drawing foils or paper strips are suitable for that purpose. The desired symbols are drawn onto the visible fields.

The following drawing shows the dimensions of the labeling strips as well as their location in the BTC05 casing. The strips are inserted into the slots provided for that purpose.

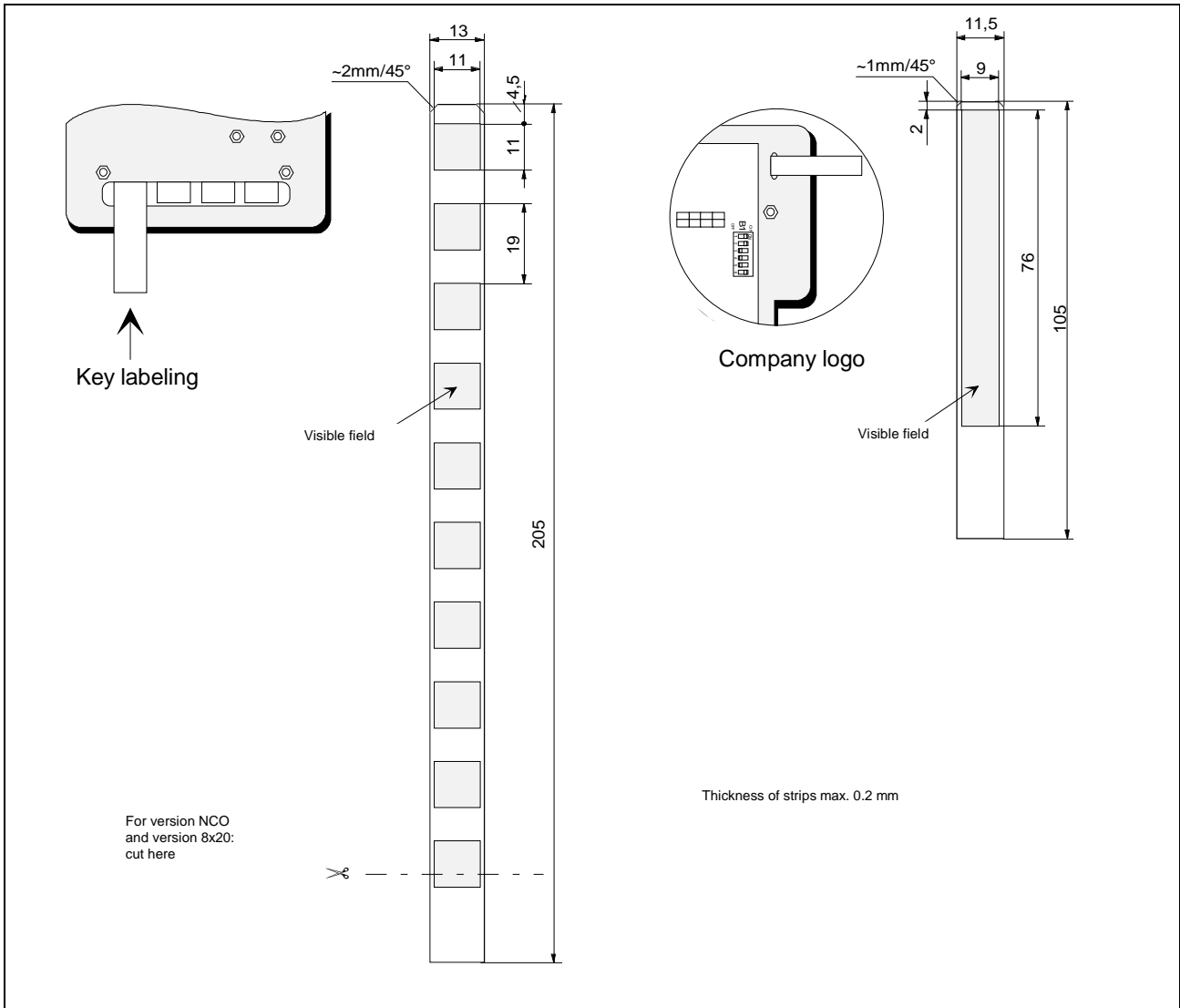


Fig. 5-1: Dimensions of labeling strips

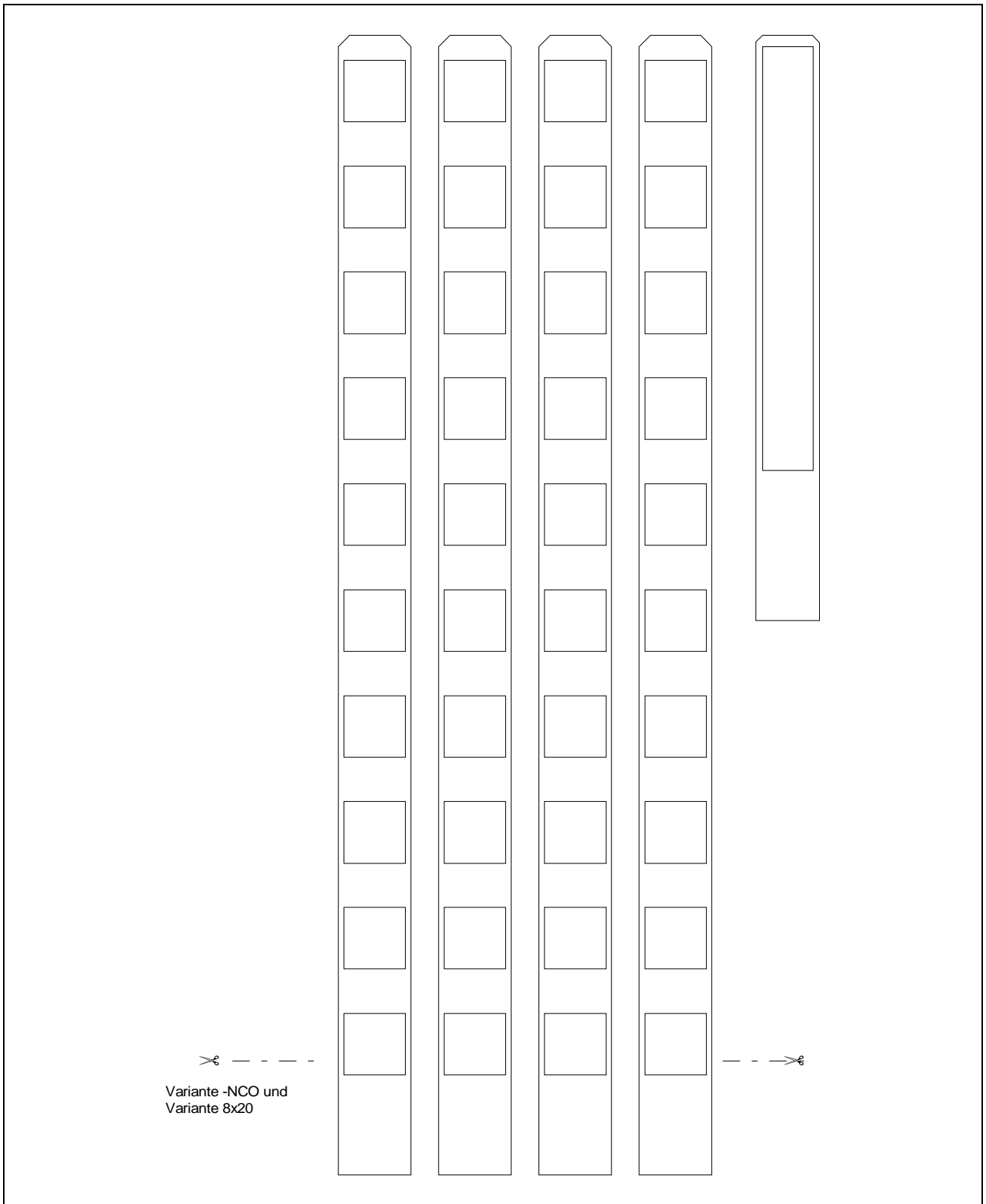


Fig. 5-2: Labeling strips scale 1 : 1

5.1 Programming Example - Key Labeling

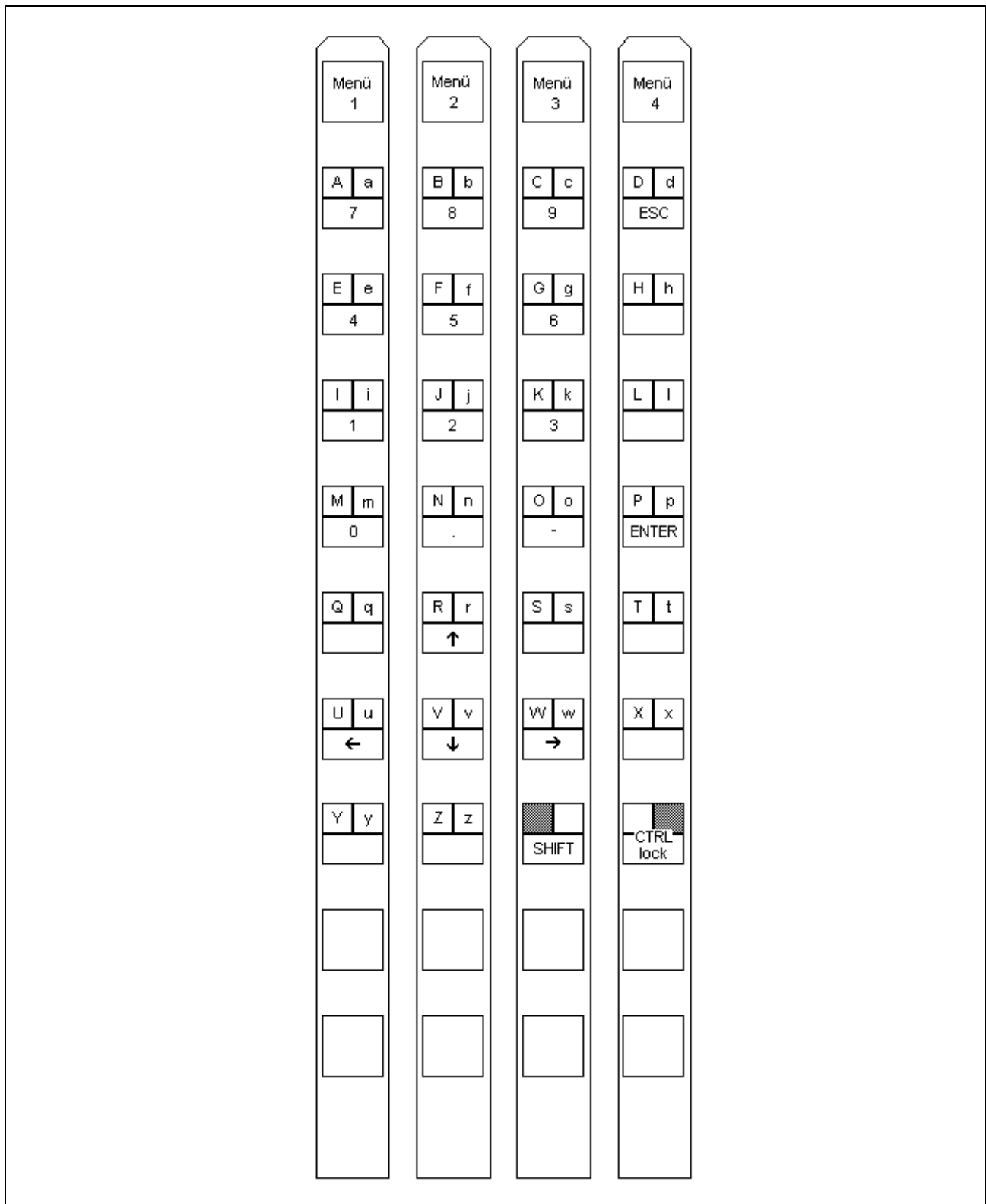


Fig. 5-3: Key assignment of the programming example

6 Display Character Set

The following list provides an overview of the ASCII characters that can be displayed on the handheld terminal.

Dec	Dec	Hex	ASCII	Dec	Hex	ASCII
32	68	44	D	105	69	i
33	69	45	E	106	6A	j
34	70	46	F	107	6B	k
35	71	47	G	108	6C	l
36	72	48	H	109	6D	m
37	73	49	I	110	6E	n
38	74	4A	J	111	6F	o
39	75	4B	K	112	70	p
40	76	4C	L	113	71	q
41	77	4D	M	114	72	r
42	78	4E	N	115	73	s
43	79	4F	O	116	74	t
44	80	50	P	117	75	u
45	81	51	Q	118	76	v
46	82	52	R	119	77	w
47	83	53	S	120	78	x
48	84	54	T	121	79	y
49	85	55	U	122	7A	z
50	86	56	V	123	7B	{
51	87	57	W	124	7C	|
52	88	58	X	125	7D	}
53	89	59	Y	129	81	ü
54	90	5A	Z	130	82	é
55	91	5B	[	131	83	â

56		9 3	5D	]	132	84	ä
57		9 4	5E	^	133	85	à
58		9 5	5F	_	136	88	ê
59		9 6	60	`	138	8A	è
60		9 7	61	a	140	8C	î
61		9 8	62	b	142	8E	Ë
62		9 9	63	c	147	93	û
63		1 0 0	64	d	148	94	ö
64		1 0 1	65	e	149	95	ô
65		1 0 2	66	f	151	97	ù
66		1 0 3	67	g	153	99	Ö
67		1 0 4	68	h	154	9A	Ü

On the 4-line display, the character û (Dec 147, Hex 93) is displayed as u and the character ô (Dec 149, Hex 95) as o.

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9 Service & Support

9.1 Helpdesk

Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns

- Telefonisch: **+49 (0) 9352 40 50 60**
über Service-Call Entry Center Mo-Fr 07:00-18:00
- per Fax: **+49 (0) 9352 40 49 41**
- per e-Mail: **service@indramat.de**

Our service helpdesk at our headquarters in Lohr am Main, Germany can assist you in all kinds of inquiries. Contact us

- by phone: **+49 (0) 9352 40 50 60**
via Service-Call Entry Center Mo-Fr 07:00 am -6:00 pm
- by fax: **+49 (0) 9352 40 49 41**
- by e-mail: **service@indramat.de**

9.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

oder **+49 (0) 171 333 88 26**
+49 (0) 172 660 04 06

After helpdesk hours, contact our service department directly at

or **+49 (0) 171 333 88 26**
+49 (0) 172 660 04 06

9.3 Internet

Weitere Hinweise zu Service, Reparatur und Training finden Sie im Internet unter

www.indramat.de

Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit Ihrem lokalen Ansprechpartner auf. Die Adressen sind im Anhang aufgeführt.

Additional notes about service, repairs and training are available on the Internet at

www.indramat.de

Please contact the sales & service offices in your area first. Refer to the addresses on the following pages.

9.4 Vor der Kontaktaufnahme... - Before contacting us...

Wir können Ihnen schnell und effizient helfen wenn Sie folgende Informationen bereithalten:

1. detaillierte Beschreibung der Störung und der Umstände.
2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Tel./Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

For quick and efficient help, please have the following information ready:

1. Detailed description of the failure and circumstances.
2. Information on the type plate of the affected products, especially type codes and serial numbers.
3. Your phone/fax numbers and e-mail address, so we can contact you in case of questions.

9.5 Kundenbetreuungsstellen - Sales & Service Facilities

Verkaufsniederlassungen
 Niederlassungen mit Kundendienst

sales agencies
 offices providing service

Deutschland – Germany

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Notes



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