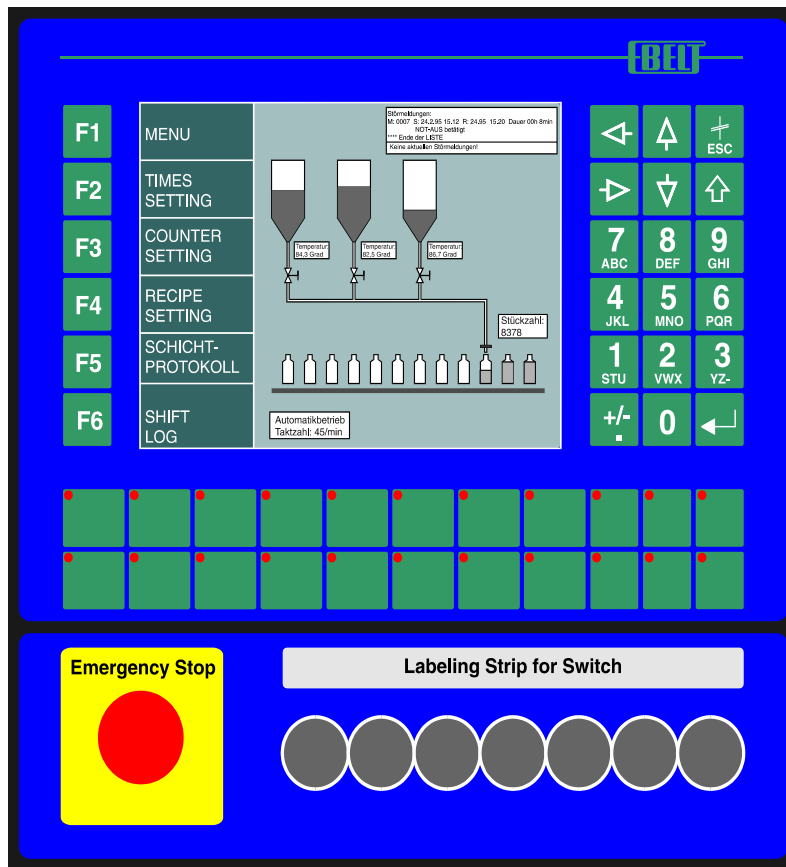


MANUAL BT1000



Operator Panel with Graphics Capability for Efficient Machine Operator Control and Monitoring:

- PLC offloading: Programmable Application Interface (PAI), menu memory, recipe memory, real-time clock, password protection
- Connection for printer, scanner, disk drive, card reader, host computer, etc. through reloadable drivers.
- Language selection for CE-compatible, worldwide use, CE mark of conformity, tested to IEC, VDE and EN standards
- Fault diagnosis via bit field evaluation, 4 priorities: alarm, fault, warning, note Programmable acknowledgment behavior, import of fault message texts from ASCII files
- Full-graphics display, any combination of texts and graphics scaling of graphical and numerical variables
- 26 freely programmable function keys, labeling through slide-in identification strips
26 programmable LEDs in function keys
- Communication protocols for all major PLC products
Integrated PG-MUX for direct connection to programming unit interface of PLC
- Field bus interface modules for CAN, Suconet K1, InterBus-S, Profibus-DP
Gateway for Modbus+, additional protocols on request

Performance Specifications

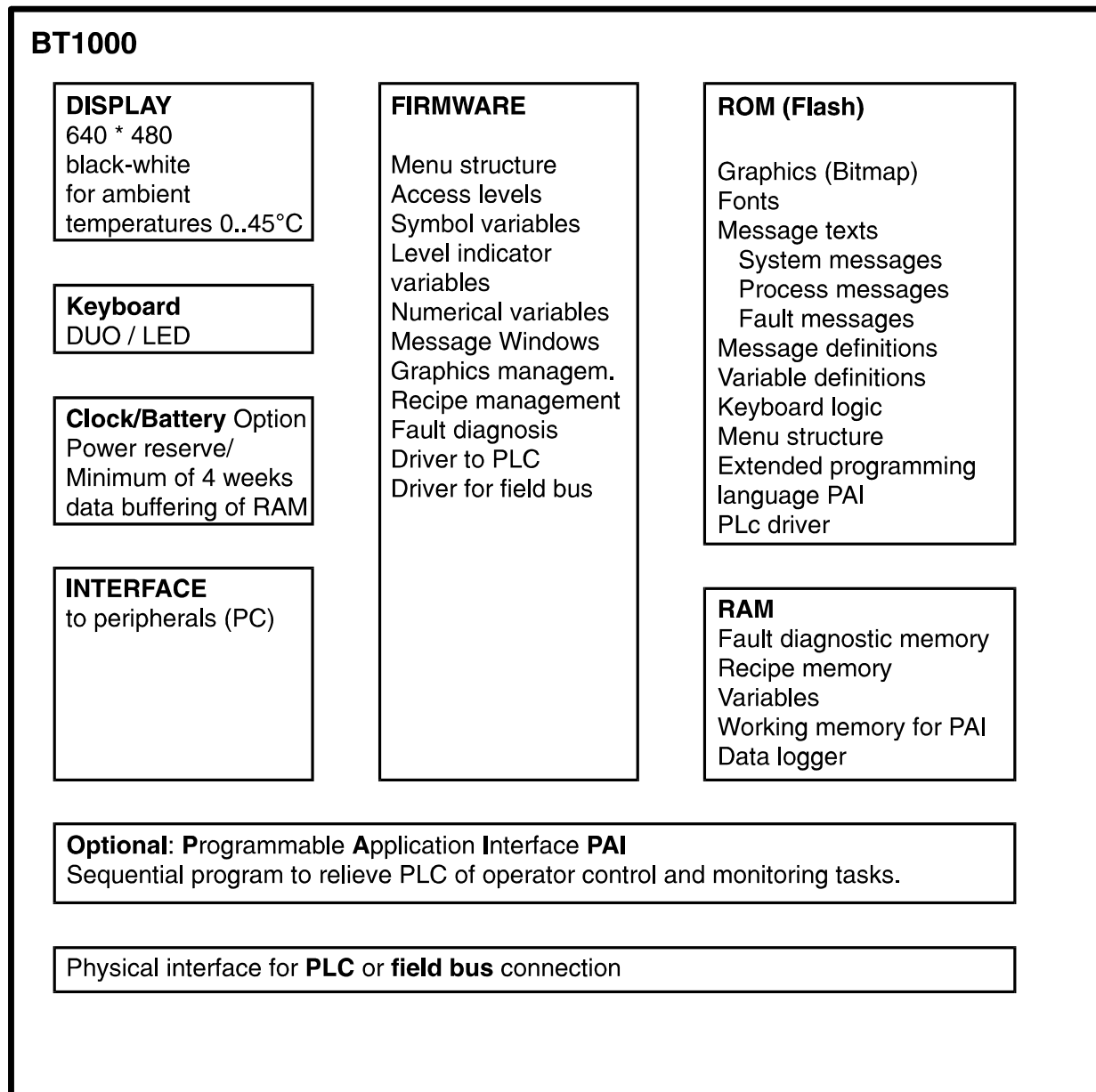
Casing	Front dimensions	360 mm x 360 mm
	Panel cut-out	320 mm x 320 mm
	Mounting depth	50 mm
	Protection class	IP 65, on front after mounting
Connection	Power supply	24 V = (18 ... 32 V)
	Current consumption	300 mA typ.
	Interference immunity	IEC 801-2, 8 kV air discharge IEC 801-4 / IEC 801-5, class 4
Display		LCD mono CFL background lighting
	Resolution	640 x 480 pixels (VGA)
	Active area	192 mm x 144 mm
Keyboard feedback		46 membrane keys, embossed with tactile
Memory option)		22 of these keys with DUO-LED
	Project memory	384 kByte Flash
	additional	512 kByte Flash
	Event / recipe memory	60 kByte RAM (250kByte RAM
	Clock (RTC)	+/- 50 ppm (option)
	Data buffering for RTC and event memory, minimum. 4 weeks battery buffering	
Interfaces	COM 1	RS 232 for connection to PC
	COM 2	RS 422 / RS 485 / RS 232 / 20 mA interface design depends on PLC
Field buses		CAN, Suconet K1, Profibus-DP InterBus-S, Modbus+
Ambient temperature:		
	Storage	-20 ... +60° C
	Operation	0 ... +45° C

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1. General Organization



With the BT1000, we offer an operator panel for complete machine operator control. Aluminum front panels and zinc-coated plate steel casings provide for interference-free employment even in harsh industrial environments. On account of the sealed front mounting of the BT1000, an IP65 degree of protection is obtained. Inserting the labeling strips from the sealed inner side of the device ensures that this degree of protection is maintained. Extensive tests have shown that the BT1000 is both reliable and suitable for use in industrial applications. Mechanical stability, EMC, temperature and climatic tests ensure that the high level of quality of the operator panels is maintained. The monochrome LCD display features CFL background lighting offering high readability from various directions. A resolution of 240 x 128 pixels allows for a spacious display of texts and graphics. Exchangeable interface modules allow ease of adaptation to various interface standards and various bus systems. The protocol drivers can be loaded using the programming software. It is not necessary to order the BT1000 in a protocol-specific manner. This manual provides a detailed description of the various elements of the BT1000.

1.0 Display Areas

The display area of the BT1000 can be divided into three basic, independent areas:

- 256 background graphics
- up to 1000 menu elements for the menu structure
- Lists for fault diagnosis
- Message windows for system messages

Background graphics include

- Graphics (Bitmap)
- Message windows
- Level indicator variables
- Blink variables
- Symbol variables

Menu elements include

- Texts
- Graphics (Bitmap)
- Numerical variables of the described formats
- Symbol variables

Lists for fault diagnosis include

- Fault message texts
- Time information on start of fault
- Time information on end of fault
- Time information on duration of fault

Message windows include

- Message texts
- Numerical variables of the described formats
- Symbol variables (object variables)
- Graphics (Bitmap)

Message windows for system messages include

- System messages appear on the display only, when errors are detected by the operating system of the BT1000. For a description of the meaning of each message see the section "System Messages".

This simple structure should be memorized carefully in order to maintain an overview of the wide range of different configuration options.

1.0.0 Keys

The BT1000 is provided with a high-quality membrane keyboard comprising a total of 57 large, embossed keys with excellent tactile feedback. The keyboard is divided into 3 groups: input keyboard (numerical and cursor keys), 5 menu function keys and 26 freely assignable function keys with LEDs.

1.0.0.0 Input Keyboard

The input keyboard allows input of values into variables. In addition, every push of a button is transferred to the PLC as a code (see allocation in WR_PLC).

1.0.0.1 Menu Function Keys

The function of the menu function keys (6 keys located to the left of the screen) is determined in conjunction with the menu elements. In addition, every push of a key is transferred to the PLC in bit mode.

1.0.0.2 Function Keys with LEDs

The BT1000 comprises 26 function keys (S1 .. S26). Each of these function keys is provided with a LED and allows for labeling. Each key can be programmed to function as a push-button key or as a latch-down key. These keys are transferred to the PLC individually (in bit mode) and are thus capable of directly activating functions, independently of the menus. The LED in each function key can either be allocated to a bit in the PLC or indicate the state of the (latch-down) key. A slide-in labeling strip which can be inserted from the inner side of the device allows convenient and clear labeling of the keys while maintaining the high degree of protection (IP65).

1.0.0.3 Radio Groups

The 26 function keys (S1 .. S26) can be combined to radio groups. Radio keys are keys, that mutually activate. A radio group is identified by being assigned the same group number in the programming software BTPROWIN.

1.1 Texts/ Language Selection

The text items in the BT1000 are divided into various groups: system texts, process texts, fault message texts and text (symbol) variables. The programming software BTPROWIN is capable of managing up to 10 languages. During the download to the BT1000, it is possible to select 2 languages with the first language being the customer language and the second the service language. Since the text input is also graphic-oriented, the use of symbols and various character sets is possible.

1.1.0 System Messages (Texts)

System messages are displayed or added to the diagnostic memory by the BT1000 as a result of specific internal operating states. Variables are inserted into some of the messages. The underline character (_) is used as a filler character. The number of filler characters for compilations is also precisely specified. If no text has been programmed, the following text is displayed "Systext-No. xxx Error 12". Recommendations for texts and their meanings are listed in the appendix.

1.1.1 Process Messages

Process messages are messages that are used for representation purposes in message definitions. Messages may contain text items, graphics and variables. Up to 1000 process messages can be defined. If a process text is used that has not been programmed, the following message is displayed: "Process Text xxx Error 11".

1.1.2 Fault Messages (Texts)

Fault message texts are messages that are added to the diagnostic memory by the fault diagnosis function. The individual messages are allocated to the single bits of the bit field in a specific order of sequence. This allocation is fixed.

Message1= bit n.1, message2= bit n.2, message15= bit n.15; message16= bit n+1.0, etc. If a fault message is used that has not been programmed, the following message is displayed: "Fault Text No. xxx Error 13". Up to 1023 fault messages can be programmed. This corresponds to 64 words.

1.1.3 Symbol Variables / Object Variable Lists

Depending on a data word or a bit in a data word, it is possible to insert symbols or texts from an object variable list into a message or a background graphics. Up to 256 objects can be defined per object variable list. Up to 100 object variable lists can be created. Similar to message texts, symbol variables are also created in multiple languages.

1.1.4 Recipe Memory

Part of the RAM memory can be configured as "recipe memory". The recipe memory is a two-dimensional word-oriented array. The variable I0 is the pointer to the selected recipe. Within the recipe, data are accessed via the internal variables I1 .. In.

1.2 Fonts

Two non-proportional fonts, optimized for screen resolutions of 240x128 pixels, are supplied with the programming software BTPROWIN. They are especially suited for representation of small fonts as well as tables where proportional fonts would be disturbing. In addition, we supply the font "Passwortsymbol" (password symbol) to allow concealed input and the font "E/A - Symbol" (I/O - Symbol) which principally allows a graphical representation of binary variables. Any fonts provided by Windows can also be used. Whenever an additional font is used, the new font data are added to the data record during the compilation process.

1.3 Bitmaps

Graphic elements must be available on the hard disk as Windows-bitmaps (.bmp). Ensure that the size of the graphics does not exceed 240x128 pixels. Normal graphics use the black and white format while background graphics and graphics with level indicator variables use 16 colors (RGB). The green portion is used for the active area of a level indicator variable.

1.4 Background Graphics

The BT1000 is capable of displaying up to 256 background graphics. A background graphic may contain one or more graphics. Graphics smaller than 240x128 pixels can be placed at any position on the screen. A background graphic may contain level indicator variables, symbol variables and up to 31 message definitions.

1.5 Message Windows

Message definitions are elements which are inserted into a background graphics. A message definition consists of a size (height x width), expressed in pixels, a border (none, normal, bold, double) and a process message. Up to 31 message definitions can be used per background graphic.

1.5.1 Statical Message Windows

A statical message definition is only capable of displaying one of the process messages defined during the programming.

1.5.2 PLC-Dependent Message Windows

For PLC-dependent message definitions, the process message to be displayed is not defined when the programming is carried out but at the operating time of the PLC. During the course of programming, the address of the PLC is specified from which onwards the number of the process message to be displayed is read.

1.6 Menu Elements

Up to 1000 menu elements can be defined. Within each of the menu elements, the 5 function keys are provided with a new labeling and assume a new function. The window size for a key is 120*32 pixels.

1.6.0 Access Level, PLC-Address

A word address and an access level, one of 32, is assigned to each menu element. The PLC word address can be accessed in bit-mode provided one or more of the 5 menu function keys are programmed as switching keys. When the menu definition is activated, the contents of the PLC word address is read from the PLC and is written to the PLC upon every modification via the menu function keys. During this time period, no modifications should be made by the PLC as they would be overwritten by the BT1000.

1.6.1 On/Off - Labeling Field

Every menu function key is assigned at least 1 labeling field within each menu element. For menu function keys which are capable of assuming 2 states (direct input, switching key), the second labeling field is made use of as well. The first labeling field, in the programming software the top labeling field, is visible while the key is "OFF". The second labeling field is visible if the key is "ON". The entire menu definition is exchanged, however, if a key is programmed as a menu key, i.e. the second labeling field is never visible. The labeling fields may contain texts, graphics and variables but not message definitions.

1.6.2 Menu Switching Key

If a menu function key is programmed as a switching key, the bit assigned to this key is set in the PLC word address. Upon switching to the menu element, the key assumes the state which corresponds to that of the bit in the PLC word address. The state is indicated by the corresponding ON or OFF-labeling field. The switching key can be programmed to function as a push-button key or a latch-down key. Furthermore, it is possible to reset other menu function keys if they were set. This allows programming of mutually activating switching keys (radio keys).

1.6.3 Direct Input into a Menu

Input variables may be programmed in the ON-labeling field of a menu key that is programmed for direct input. Only one direct input can be opened at any one time. Opening a second one will result in the BT1000 automatically closing the previous input. The OFF-labeling field may contain indication variables only. Input variables will automatically be treated as indication variables. Only one menu key with input variables can be active. Opening another menu element with input variables will result in any previously open element being closed. While input variables are active on the menu bar, the input variables will not be edited in the background graphic.

1.6.4 Activating the Successive Menu

A menu function key is capable of referring to a successive element. If a key programmed accordingly is pressed, the entire menu element is exchanged. If "0" is specified for the successive element, a branch is made to an element predefined by the PLC. If in this case, the PLC predefines the element "0", the menu bar is switched off.

This process can be simulated using the programming software BTPROWIN during the course of programming.

1.7 Variables

Variables are values which are read, at the operating time, from the PLC, the recipe memory or the internal memory of the BT1000 and which are represented using the various formats.

1.7.0 Addressing

The address definitions comply with the syntax conventions of the PLC that is used. For block-oriented PLC types, the syntax used is DB:DW. In the case of PLC-types which use flag words or registers, the register number is specified as address. The permitted values are listed in the PLC-specific section of this description and the manual of the PLC being employed. All variables are read and written in word-mode.

1.7.1 Indication Variables

Indication variables are variables that are continuously read from the PLC while they are displayed on the screen. Indication variables can not be altered by means of the keyboard.

1.7.2 Input Variables

The behavior of input variables is identical to that of indication variables until input is initiated by pressing one of the numerical keys or by using one of the arrow keys. For the duration of the input, the value is not read. The entry is completed with the Return key and canceled with the ESC key.

1.7.3 Input Limits

An upper and lower input limit can be specified for input variables as part of the variable definition in the programming software BTPROWIN. Upon completion of the input, the specified



value is checked for compliance with the programmed input value ranges and if it is within the limits, is then written to the PLC.

1.7.4 Variable Formats

Various formats can be used to display variables on the screen. During the variable definition, the representation format is selected on the display.

1.7.4.1 Variable Format ASC

The filler characters are filled with ASCII characters starting with the H byte of the specified address. Only displayable characters (from 20h onwards) are permitted. ASCII variables can also be entered via the keyboard. The keys can be assigned up to four functions (in the same way as the keys on a telephone).

1.7.4.2 Variable Format BCD

The defined data word is interpreted as a 4-digit BCD-number in the range of 0 ... 9999. The number of filler characters must be between 1 and 4. If the data word has been predefined by the PLC with nibbles >9, they will be represented by the characters A to F (HEX).

1.7.4.3 Variable Format BCDL

The defined data word is interpreted as an 8-digit BCD-number in the range of 0 ... 99999999. The number of filler characters must be between 5 and 8. Two consecutive registers (data words) are always read. If the register has been predefined by the PLC with nibbles >9, they will be represented by the characters A to F (HEX).

1.7.4.4 Variable Format BIN

The defined data word is represented as 16 single bits. The number of filler characters must be between 1 and 16. The number of bits displayed corresponds to the number of defined filler characters. The input editor accepts the keys 0 and 1. During the definition, it is possible to define the start-up bit from which onwards the more significant bits are to be displayed. The process of reading from the PLC, however, involves that the entire word is read from the PLC and (if programmed as input variable) also written to the PLC. Any modifications performed by the PLC in the meantime will therefore be overwritten by this process.

1.7.4.5 Variable Format FLS

Level indicator variables are graphical variables. The horizontal or vertical expansion of an area varies in accordance with the contents of a data word. The area is read in as a bitmap. The variable is scaled during the definition. In addition to bars, polygons can be represented with angles of >90 degrees (funnels, tanks, rectangles, circles). Level indicator variables are scaled in the direction of movement.

1.7.4.6 Variable Format HEX

The defined data word is interpreted as a 4-digit HEX-number in the range of 0 ... FFFF. The number of filler characters must be between 1 and 4. The input editor only accepts the keys 0 ... 9.

The characters A ... F are produced by simultaneously pressing the key [SFT] and one of the keys 0 .. 5 (corresponds to A .. F).

1.7.4.7 Variable Format INT

The defined data word is interpreted as a signed integer in the range of -32768 ... +32767. The [+/-] key allows the sign to be reversed. When programming the filler characters, it must be taken into consideration that one additional digit is required for the sign. The number of filler characters must be between 2 and 6.

1.7.4.8 Variable Format INTL

Represents a signed 32-bit number. The number of filler characters must be between 2 and 11. Two consecutive registers are automatically used for PLC types which use 16-bit registers (data words) only.

1.7.4.9 Variable Format KT (Siemens S5 only)

The defined data word is interpreted as a 3-digit BCD number in the range of 0 ... 999. The highest 4 bits contain the time base coding. The time base with the highest resolution will automatically be implemented when storing into the data word. The number of filler characters must be 4.

Representation of the filler characters in the DW:

7,65	Time base 0	0765 (KH)
76,5	Time Base 1	1765 (KH)
765	Time Base 2	2765 (KH)
7650	Time base 3	3765 (KH)

Whenever an input can be represented using the next smaller time range, it will automatically be selected: e.g. 0012 - 12,0 (1120). Within the largest range, a zero will automatically be added if a 4-digit number is entered.

1.7.4.10 Variable Format SINT (scaled integer)

The defined data word is interpreted as a signed integer in the range of -32768 ... +32767. The [+/-] key allows the sign to be reversed. When programming the filler characters, it must be taken into consideration that one additional digit is required for the sign. The number of filler characters must be between 2 and 6. In addition, an input range of values (=contents of the data word) is specified which is imaged to an indication range of values.

1.7.4.11 Variable Format SUNS (scaled unsigned)

The defined data word is interpreted as an integer without a sign in the range of 0 ... 65535. The input editor only accepts the keys 0..9. The number of filler characters must be between 1 and 5. In addition, an input range of values (=contents of the data word) is specified which is imaged to an indication range of values.

1.7.4.12 Variable Format SYM

In the case of word variables, an element is selected from a list of object variables and represented on account of the (UNS) number in a data word. In the case of bit variables, the bit in the word address is additionally specified and the object variable assumes one of two possible states. The symbol variable can assume the property "bit position". Only those bit positions of a word (16 bits) are used that are specified in the associated mask. If none of the selected bits are set, the object variable 0 is displayed. The corresponding word will be searched from L to H for a set bit that is not masked out. Based on the bit position, the object variable 1 ... 16 is displayed. Object variables are similar to message windows, however, being variables themselves, they can not contain variables.

1.7.4.13 Variable Format UNS

The defined data word is interpreted as an integer without a sign in the range of 0 ... 65535. The input editor only accepts the keys 0..9. The number of filler characters must be between 1 and 5.

1.7.4.14 Variable Format BLK (Blink Variable)

Rectangular areas can be defined which, depending on a bit address in the PLC, are inverted at the specified blinking frequency. Blinking areas should not be directly above variables. Either the entire area can blink or just the frame around it. The frame type is defined during the programming stage.

1.8 Recipe Variables

Recipe variables are accessed via internal variables. The internal variable I1 is the first recipe entry, the internal variable I2 is the second recipe entry, etc. I(max.) is obtained from the programmed number of words / recipes. The recipe number is set in the internal variable I0. Valid values for I0 are 1... maximum number of recipes. Up to 4000 recipes can be defined.

2. Connection to the PLC

The physical connection to the PLC varies with the make of the PLC. For a more detailed description see the PLC-specific section. A serial connection via the programming unit interface is used for most PLC makes. In addition, the following "true" bus systems are available:

MODBUS+ via external gateway
 PROFIBUS DP via plug-in type interface card
 Interbus-S (remote bus)
 CAN (in preparation)

The logical connection to the PLC has been designed in such a way that it is, to a large extent, independent of the bus system and PLC driver. A distinction is made here between three communication areas:

1. Access of variables and PLC-specific message windows to the PLC word address is performed by simply specifying the address in the variable definition or during the definition of the message window. It must only be ensured that the PLC address is a valid address for the connected PLC.

2. Write block and read block (WR_PLC and RD_PLC) without using the optional programming language of the PAI (Programmable Application Interface). Two data blocks are defined here whose starting and end addresses are specified in the programming software (BTPROWIN) under >"System Set-Up" >" Driver Set-Up". The data are read from the PLC at cyclic intervals and are written primarily to the PLC if any changes are made (key actuation).

In addition, further data can be exchanged with the PLC in an event-controlled manner if PAI is used.

2.0 PLC Drivers

The following PLC drivers are available or are in preparation:

AEG Modicon A120/250 (KS-Functions)
 AEG MICROAKF
 AEG Modicon 984 (Modbus RTU)
 AEG Modicon Micro
 AEG Modicon Modbus+ connectable via external gateway (Modbus+ -> ModbusRTU)
 Allen-Bradley SLC 5/03, PLC 5/11, PLC 5/20, PLC 5/30, PLC 5/40, PLC 5/60, PLC 5/80
 Bosch BUEP 19 / BUEP 19E
 Klöckner Moeller PS 306 / PS 316 via SucomA
 Klöckner Moeller PS4-200 / Suconet K1 (special plug-in type interface card required in BT1000)
 Mitsubishi Series FX / FX0
 Omron Series H, Series CQM
 Siemens S5 (L1)100U CPU 103 / 90U / 95U / 115U
 Siemens S5 (SAS)115U / 135U / 155U (SAS525 interface card allows connection of up to 16 devices)

Siemens (Profibus DP) (special plug-in type interface card required in BT1000). A data handling block for S7-300 is available.

Interbus-S digital remote bus station (special plug-in type interface card required in BT1000)

(additional available on request)

2.1 WR_PLC

The meaning of the data block is described here if the optional programming language PAI is not used. If any changes are made (key actuation), this data block is written primarily to the PLC. The actual address in the PLC is obtained from the input made for WR_PLC in the programming software BTPROWIN. The transmission is word-oriented. Certain makes of PLCs, however, allow addressing of even word addresses only (Siemens S7, certain Bosch PLC types, certain Klöckner-Moeller PLC types). The PLC driver takes this into consideration. Instead of "n, n+1, n+2, ..", the order will then be "n, n+2, n+4, ...". These values have therefore been enclosed between parenthesis.

n	Bit 0...3	Control Word, numerical key is pressed, no key=0Fh
n	Bit 4	Shift key is pressed
n	Bit 5	Variable transmission BT -> PLC in progress
n	Bit 6	Enter key is pressed
n	Bit 7	Life bit (is inverted no later than every 5s)
n	Bit 8	ESC key
n	Bit 9	Arrow left
n	Bit 10	Arrow right
n	Bit 11	Arrow up
n	Bit 12	Arrow down
n	Bit 13 .. 14	Unassigned
n	Bit 15	one or more faults present
n+1(n+2) active)	Bit 0...9	Menu element currently active (0=no element)
n+1(n+2)	Bit 10	Menu function key F6 (Page key)
n+1(n+2)	Bit 11	Menu function key F5 (Shift + Page key)
n+1(n+2)	Bit 12	Menu function key F4
n+1(n+2)	Bit 13	Menu function key F3
n+1(n+2)	Bit 14	Menu function key F2
n+1(n+2)	Bit 15	Menu function key F1
n+2(n+4)	Bit 0	Function keys S16
n+2(n+4)	Bit 1	Function keys S15
n+2(n+4)	Bit 2	Function keys S14
n+2(n+4)	Bit 3	Function keys S13
n+2(n+4)	Bit 4	Function keys S12
n+2(n+4)	Bit 5	Function keys S11
n+2(n+4)	Bit 6	Function keys S10
n+2(n+4)	Bit 7	Function keys S9
n+2(n+4)	Bit 8	Function keys S8
n+2(n+4)	Bit 9	Function keys S7
n+2(n+4)	Bit 10	Function keys S6
n+2(n+4)	Bit 11	Function keys S5
n+2(n+4)	Bit 12	Function keys S4
n+2(n+4)	Bit 13	Function keys S3
n+2(n+4)	Bit 14	Function keys S2
n+2(n+4)	Bit 15	Function keys S1
n+3(n+6)	Bit 0	Function keys S24
n+3(n+6)	Bit 1	Function keys S23
n+3(n+6)	Bit 2	Function keys S22
n+3(n+6)	Bit 3	Function keys S21
n+3(n+6)	Bit 4	Function keys S20
n+3(n+6)	Bit 5	Function keys S19
n+3(n+6)	Bit 6	Function keys S18
n+3(n+6)	Bit 7	Function keys S17
n+3(n+6)	Bit 8	Acknowledgement for recipe transmission

n+3(n+6)	Bit 9	Acknowledgement for transmission of time from PLC
n+3(n+6)	Bit 10,11,12	Unassigned
n+3(n+6)	Bit 13	Function keys S26
n+3(n+6)	Bit 14	Function keys S25
n+3(n+6)	Bit 15	Restart flag, during initialization=1, until PLC has set all request flags = 0.
n+4(n+8)	Bit 0	Key Z1
n+4(n+8)	Bit 1	Key Z2
n+4(n+8)	Bit 2	Key Z3
n+4(n+8)	Bit 3	Key Z4
n+4(n+8)	Bit 4	Key Z5
n+4(n+8)	Bit 5	Key Z6
n+4(n+8)	Bit 6	Key Z7
n+4(n+8)	Bit 7	Key Z8
n+4(n+8)	Bit 8..15	Unassigned
n+5(n+10)	Bit 0...15	Time, Hrs : MIN packed BCD (H-byte : L-byte)
n+6(n+12)	Bit 0...15	Date, Month: Day packed BCD (H-byte : L-byte)
n+7(n+14)	Bit 0...15	Date, Weekday: Year packed BCD (H-byte : L-byte)

2.2 RD_PLC

Describes the meaning of the data block if the optional PAI programming language is not used. This data block is read from the PLC at cyclic intervals. The actual address in the PLC is obtained from the input made for WR_PLC in the programming software BTPROWIN. The transmission is word-oriented. Certain makes of PLCs, however, allow addressing of even word addresses only (Siemens S7, certain Bosch PLC types, certain Klöckner-Moeller PLC types). The PLC driver takes this into consideration. Instead of "n, n+1, n+2, ..", the sequence will then be "n, n+2, n+4, ...". These values have therefore been enclosed between parenthesis.

n	Bit 0...7	Display graphic no. range 0...255
n	Bit 8	Transmit recipe (request from PLC)
n	Bit 9	Read clock from PLC and set clock
n	Bit 10...12	Unassigned
n	Bit 13	Initiate restart, Reset and disable F-keys, if bit=0. bit=1: normal operation
n	Bit 14	Write time to PLC at cyclic intervals (once every min)
n	Bit 15	Transmission direction of the recipe 0=write to PLC, 1= read from PLC
n+1(n+2)	Bit 0...9	Start-up element menu
n+1(n+2)	Bit 10...14	Release access level (0...31)
n+1(n+2)	Bit 15	Control menu element unconditionally from PLC
n+2(n+4)	Bit 0	Blinking status of the LED in S16
n+2(n+4)	Bit 1	Blinking status of the LED in S15
n+2(n+4)	Bit 2	Blinking status of the LED in S14
n+2(n+4)	Bit 3	Blinking status of the LED in S13
n+2(n+4)	Bit 4	Blinking status of the LED in S12
n+2(n+4)	Bit 5	Blinking status of the LED in S11
n+2(n+4)	Bit 6	Blinking status of the LED in S10
n+2(n+4)	Bit 7	Blinking status of the LED in S9
n+2(n+4)	Bit 8	Blinking status of the LED in S8
n+2(n+4)	Bit 9	Blinking status of the LED in S7
n+2(n+4)	Bit 10	Blinking status of the LED in S6
n+2(n+4)	Bit 11	Blinking status of the LED in S5
n+2(n+4)	Bit 12	Blinking status of the LED in S4
n+2(n+4)	Bit 13	Blinking status of the LED in S3
n+2(n+4)	Bit 14	Blinking status of the LED in S2

n+2(n+4)	Bit 15	Blinking status of the LED in S1
n+3(n+6)	Bit 0	Yellow LED in S16
n+3(n+6)	Bit 1	Yellow LED in S15
n+3(n+6)	Bit 2	Yellow LED in S14
n+3(n+6)	Bit 3	Yellow LED in S13
n+3(n+6)	Bit 4	Yellow LED in S12
n+3(n+6)	Bit 5	Yellow LED in S11
n+3(n+6)	Bit 6	Yellow LED in S10
n+3(n+6)	Bit 7	Yellow LED in S9
n+3(n+6)	Bit 8	Yellow LED in S8
n+3(n+6)	Bit 9	Yellow LED in S7
n+3(n+6)	Bit 10	Yellow LED in S6
n+3(n+6)	Bit 11	Yellow LED in S5
n+3(n+6)	Bit 12	Yellow LED in S4
n+3(n+6)	Bit 13	Yellow LED in S3
n+3(n+6)	Bit 14	Yellow LED in S2
n+3(n+6)	Bit 15	Yellow LED in S1
n+4(n+8)	Bit 0	Blinking status of the LED in S26
n+4(n+8)	Bit 1	Blinking status of the LED in S25
n+4(n+8)	Bit 2	Blinking status of the LED in S24
n+4(n+8)	Bit 3	Blinking status of the LED in S23
n+4(n+8)	Bit 4	Blinking status of the LED in S22
n+4(n+8)	Bit 5	Blinking status of the LED in S21
n+4(n+8)	Bit 6	Blinking status of the LED in S20
n+4(n+8)	Bit 7	Blinking status of the LED in S19
n+4(n+8)	Bit 8	Blinking status of the LED in S18
n+4(n+8)	Bit 9	Blinking status of the LED in S17
n+4(n+8)	Bit 10..15	Unassigned
n+5(n+10)	Bit 0	Yellow LED in S26
n+5(n+10)	Bit 1	Yellow LED in S25
n+5(n+10)	Bit 2	Yellow LED in S24
n+5(n+10)	Bit 3	Yellow LED in S23
n+5(n+10)	Bit 4	Yellow LED in S22
n+5(n+10)	Bit 5	Yellow LED in S21
n+5(n+10)	Bit 6	Yellow LED in S20
n+5(n+10)	Bit 7	Yellow LED in S19
n+5(n+10)	Bit 8	Yellow LED in S18
n+5(n+10)	Bit 9	Yellow LED in S17
n+5(n+10)	Bit 10...15	Unassigned
n+6(n+12)	Bit 0 ... 15	Unassigned
n+7(n+14)	Bit 0...15	Recipe number (binary)
n+8(n+16)	Bit 0...15	Starting address of recipe in PLC
n+9(n+18)	Bit 0...15	Time Hour :min packed BCD (H-byte : L-byte)
n+10(n+20)	Bit 0...15	Date Month : Day packed BCD (H-byte : L-byte)
n+11(n+22)	Bit 0...15	Date Weekday : Year packed BCD (H-byte : L-byte)

2.3 Handshake Procedure during Data Transfer

A handshake procedure is required for all sequential functions to ensure a proper transmission from and to the PLC. The most efficient procedure compares 2 corresponding bits of the transmitter and receiver of a message and defines:

Not identical = new message (request),

Identical = message has been read or requested action accomplished (acknowledgement).

This is the procedure that is used for the BT1000.

The procedure is as follows:

1. Request bit and acknowledgement bit do not match
2. Carry out requested action
3. Set acknowledgement bit to same state as request bit

2.4 Restart initiated by BT1000

When restarting the PLC or BT1000, the request bits must be synchronized with the acknowledgement bits. For this purpose, the restart flag (WR_PLC n+3.15) is set by the BT1000 and is not reset until the PLC has set all request bits to zero and RD_PLC n.13 has been set to 1 by the PLC. After a restart, the BT1000 sets all acknowledgement bits to zero.

2.5 Synchronization when a Restart is Initiated by the PLC

The PLC sets bit 13 in RD_PLC. As long as this bit is reset, all F-keys are blocked and all latch-down keys are reset. The BT1000 acknowledges with restart flag = 1.

2.6 Start-up Element Menu

The PLC (or the PAI) can display a menu element in RD_PLC+1 (RD_PLC+2) bit 0...9 if no element is active or can call a menu element unconditionally by setting bit 15. If element 0 is called with the set bit 15, the menu bar display is suppressed.

If a branch is made to the successive element "0" in the menu structure, the program jumps instead to the element preselected by the PLC. If the PLC specifies the element "0", the menu bar is deactivated if a branch is made to the element "0".

The menu element that is currently active is indicated to the PLC in WR_PLC+1.

2.7 Variables / Variable Optimization

For optimization of the transmission rate, up to 256 variables are combined to one block and are imaged to an internal memory area. The areas depend on the respective PLC and are described in the PLC-specific section of this manual.

2.8 Recipe Transfer

The transmission of a recipe (= 1 line in a two-dimensional data array) requires programming of the following sequence in the PLC:

1. Entering of the recipe number in (RD_PLC+7)
2. Entering of the destination or source address in the PLC in (RD_PLC+8)
3. Setting of the transmission direction (RD_PLC.15)
4. Initiation of the transmission by inverting (RD_PLC.8)
5. Waiting for acknowledgement from BT1000.

Once the transmission is completed, the BT1000 acknowledges the request by setting bit (WR_PLC+3.8) to the same state as the request flag. The number of transmitted words is a result from the number of words per recipe (setting in the programming software).

2.9 Reading Clock from PLC and Setting Clock

The sequence required to set the clock in the BT1000 is analogous to the one required for recipe transmission. The valid time values must be available in RD_PLC+9 ... RD_PLC+11.

2.10 Transmitting Clock to PLC at Cyclic Intervals

If bit (RD_PLC.14) corresponds to "1", the time will be transmitted to the PLC once every minute. For the duration of the transmission, the bit "variable transmission in progress" (WR_PLC.5) is set.

3. Programming Software

Programming of the BT1000 does not involve the exchange of memory modules but the transmission of data from the PC to the BT1000 using the programming software "BTPROWIN" (under Windows ®, Windows 95® or Windows NT®) on the PC. The connection to the BT1000 is established via the programming interface COM1: (of the BT1000). On the PC-side, com1: to com4: can be selected. For ease of handling, the driver for the PLC being used is loaded to the BT1000 together with the project data. To avoid this process from occurring every time, a corresponding switch is available in the programming software. Upon delivery, a simulation driver is loaded which simulates the connection to the PLC internally.

System requirements:

- Hardware:** Pointing device (mouse)
 1 serial interface
 386SX and higher
 minimum of 4 MB RAM
 minimum of 2 MB free memory on hard disk
- Software:** Windows® 3.11 or higher, Windows95®, Windows NT®
 Drawing program for processing of bitmaps (.bmp).

3.1 Installation of the Programming Software

The installation disk contains the programming software in a compressed format. To install BTPROWIN, the following steps must be carried out:

- Start Windows 3.xx from your hard disk
- Insert your BTPROWIN disk containing the installation program into drive A: or B:
- Activate the Program Manager
- Select:
 - File
 - Execute
 - Search
 - a: (or b:)
 - Install.exe

The installation is automatic. You will be prompted to specify the destination drive and the sub-directory to which the programming software is to be copied. The drivers for the PLC connection and the program "BTPROWIN" must be located in the same directory ("BTPROWIN").

3.2 Starting the Programming Software

Start BTPROWIN from within its program group (icon).

Select "File" and choose:

- "New Project"
- "Open Project"
- "Exit"

If you select the item "New Project", a sample project "BT1000.neu" (BT1000.new) will be loaded. This is where you can store your own sample project by renaming the project data of your choice to "BT1000.neu" (BT1000.new).

3.2.1 Editing Project

If you have opened an existing project or created a new project, select "Edit Project" at this point. Then begin defining the system set-up.

3.2.1.1 System Set-Up

This is where your BT1000 is configured. First of all, the driver to the PLC is selected. BTPROWIN requires information on the selected driver to represent the following windows accordingly. The PLC drivers are separate binary files which are not to be altered.

3.2.1.1.1 Device Set-Up

This is where the RAM is divided into fault diagnosis, PAI-reservation and recipe memory.

3.2.1.1.1.2 Fault Diagnosis

This is where the definition is made whether an automatic fault diagnosis through the evaluation of a bit field is to occur. The starting address and the size can be specified in word-mode. In addition, the definition is made here, whether a fault = bit set (working current principle) or a fault = bit reset (closed-circuit current principle). The setting New Value Message indicates that the most recent message of the highest priority is displayed. The setting First-up Message results in the fault message which was recognized first and which is of the highest priority to be displayed. The assignment of fault message texts is in bit-mode. Bit 0 of the first word = fault message 0. Fault message 0 has a special status: the bit field is reset and reread from the PLC. Bit 1 = first fault message, bit 15 = fault message 15. Bit 0 of the 2nd word = fault message 16, etc.

The memory area for the diagnostic memory is reserved here in 1kByte steps.

3.2.1.1.1.3 Recipes

The BT 15 is equipped with a recipe memory, provided the memory expansion board with real-time clock is installed. The memory is configured as a two-dimensional array. The parameter to be specified corresponds to the number of recipes and the number of entries per recipe. Each entry is a 16-bit word. The size of the memory required for the recipe memory is calculated on the basis of the defined "number of recipes" and "words/recipe". On account of the definition being made in word-mode (16 bits); it must be taken into account that 32-bit variables require 2 words. The length of ASCII variables depends on the respective definition (2 characters per word).

3.2.1.1.1.4 Blinking Intervals

Text items as well as LEDs in the function keys are capable of blinking independently. This is where the "ON" and "OFF" intervals can be defined. The value settings apply to blinking texts, blinking variables and blinking LEDs in the function keys.

3.2.1.1.2 Keyboard Set-Up

Each of the 26 function keys (S1 .. S26) can be programmed as a push-button key or as a latch-down key. Each LED in the function keys is either capable of indicating the state of the (latch-down) key (=internal) or the state of an assigned bit in the PLC (=external). The assignment LED - PLC is defined in RD_PLC. The assignment key - PLC is contained in WR_PLC. The 26 function keys can be combined to radio groups. Radio keys are keys that mutually activate. A radio group is identified by being assigned the same group number in the programming software BTPROWIN.

3.2.1.1.3 Driver Set-Up

3.2.1.1.3.1 Network Address:

This value is applicable if the PLC driver allows several stations. This value must be specified even if the physical design of the interface (RS232, TTY) permits only a point-to-point connection.

3.2.1.1.3.2 RD_PLC:

This is where the starting address is specified from which onwards the "RD_PLC" block is read from the PLC. This does not affect the reading and writing of variables.

3.2.1.1.3.3 WR_PLC:

This is where the starting address is specified from which onwards the "WR_PLC" block is written to the PLC. This does not affect the reading and writing of variables.

3.2.1.1.3.4 Variable Address Min, Max.:

This is where the maximum read and write range for variables is defined. This monitoring process is particularly important if indexed variables are used since, in the case of programming errors, write operations outside of the permitted range might occur. The index is read at the operating time of the PLC, which means that such a programming error can not be prevented by the programming software BTPROWIN.

3.2.1.2 Variable Definition

Variables are globally defined in the programming software BTPROWIN and may then be used in messages and menus. Each variable has a name, a format, a parameter and an address. BTPROWIN is capable of sorting the variables in accordance with their name, address or format.

3.2.1.2.1 Editing Variables

A variable is selected from a list and its properties can be modified in a window which appears after the selection of the function "Edit". Modification of the variable format at a later date is not possible. The parameters of a variable depend on the variable format. The "TEXT" is composed of filler characters () and fixed texts. The filler characters are replaced at operating time with variables from the PLC. In the case of symbol variables, the number of the object variable list is specified as parameter. For level indicator variables, the name of the graphics file containing the filling area is specified.

3.2.1.3 Editing Background Graphics

Up to 256 background graphics can be created. Background graphics consist of bitmaps, up to 30 message definitions and level indicator variables. Up to 250 variables can simultaneously be displayed on the screen. This number is made up of the variables in the message definitions in the background graphic, the level indicator variables in the background graphic, the symbol variables as well as the variables in the currently active menu element. The following functions are available: "Insert Bitmap", "Insert Message Window", "Insert Variable", "Delete Element", "Object to Foreground" and "Object to Background".

3.2.1.4 Message Editor

The message editor for the process, system and fault messages differentiates between the text mode (Ctrl+T) and graphics mode (Ctrl+G). In graphics mode, graphic and text elements are placed.

In the text mode, texts are written, variables are inserted and font attributes are set.

3.2.1.5 Editing Process Messages

Process messages are capable of containing texts, variables and bitmaps. If the editor is activated from within the message definition, the size of the labeling fields is the same as the size of the message definition. If the editor is activated directly, the labeling fields are displayed in accordance with a default size.

3.2.1.6 Editing System Messages

The editor for system messages is similar to the editor for process messages. The meaning of the individual messages is predefined (see 1.1.0). In this context, it must be taken into account that filler characters are inserted for variables in some of the messages without a variable being defined. The order and meaning of filler characters is fixed.

3.2.1.7 Editing Fault Messages

The message window of fault messages has a fixed size. Fault messages are capable of containing text items, but not variables.

Software tools which allow direct importing of fault messages from text files are in preparation.

3.2.1.8 Editing the Menu Structure

A description of the menu logic and the function of the menu elements has already been given in paragraph 1.5. The programming software "BTPROWIN" displays each of the 5 menu function keys with one labeling field for "OFF" and one for "ON". The element no., access level and word address are displayed in the upper menu button. The PLC word address and the access level must have been specified before programming of the keys in a new menu element is possible. The button "GO" can be used to jump to a specific menu element or to create a new element. Each of the 5 menu function keys is defined as a menu switching key (see 1.5.2), as "direct input" (see 1.5.3) or successive menu key (see 1.5.4). Selecting the button next to the labeling fields causes the associated input window to be displayed.

The function of the menu structure can be simulated using the programming software BTPROWIN. By simply pressing the mouse button, it is possible to switch to a successive element with the programming software.

3.2.1.9 Editing Object Variables

Object variables are required for symbol variables. Object variables are edited the same way as messages. They are also capable of containing texts and bitmaps. It is, however, not possible to insert variables (nesting depth too large). The size of the window can be modified by adjusting the separation line at the top of the first window (top left).

4. Connecting to the PLC

This section deals with the part of the BT 15 that is specific to the PLC. Here, you will find an explanation of what interface hardware is needed, what the assignments of the connecting cable to the PLC should look like and how the data is stored in the PLC. Special PLC software (data handling blocks) are needed for some makes of PLCs. Wherever necessary, the programs are mentioned in this description. An integrated PG-MUX is available for a number of PLC makes. Their availability and limits are described here.

Wiring layout, shielding and measures to prevent interference voltage.

When using 24V power supplies, attention must be paid to reliable electrical isolation of the extra-low voltage. The safety and accident prevention regulations applicable to the application must be observed and obeyed. Machines and systems that feature operator panels are subject to the relevant EN, IEC and VDE regulations.

The layout of components in the control cabinet has an essential influence on undisturbed functioning of a system or machine. During the course of planning and realization, attention must be paid to ensuring that the power and control sections are arranged separately.

Ebelt GmbH operator panels are connected to your machines by two kinds of lines:

1. Power supply lines
2. Data lines

Power supply lines are generally laid as unshielded lines. Only in the event of extreme electromagnetic influences may shielding be necessary. In such cases, however, it is better to shield the interference source. The data lines are laid as shielded lines. In order to avoid equalizing currents in the shield, the shield is grounded directly with low impedance on the one side and is isolated on the other end via a capacitor. Always use metallic or metallized connector housings. The braided shield should be connected over as large a surface of the connector housing as possible and with good electrical conduction.

Selection of the data line depends on its length and on expected interference sources. Do not route data and power supply lines within the same shield.

The lengths of lines between the operator panel and the PLC must not exceed the values that have been approved by the PLC manufacturer.

Do not choose a line length that is longer than necessary.

Always observe the PLC manufacturer's installation commands because, in many cases, the specifications applicable to the PLC interface are much stricter than would be necessary for reliable operation of the panel. If the line to the operator panel should be longer than is permitted by the PLC manufacturer's specifications, we offer corresponding interface converters featuring electrical isolation.

For spur lines on a bus line, we recommend the use of our SKV485 interface distributor.

Programming Cable

Cable for BT 15 programming.

The interface COM1: (RS232) is used to load the project data, the PAI program and the PLC driver from the PC to the BT1000.

4.1 AEG - Modicon A120 / A250 (KS-Functions)

Order Designations

BT1000 Interface: PLC programming interface (RS232, TTY, RS422/485 & Programming interface COM1: (RS232))

PLC Driver: AEG12xxx.btg

Interface Setting: KS-Functions/ 9600 Baud / 8 Bits / Odd Parity / 1 Stop Bit
The RS232 interface (electrically isolated) is used.

Installation Set:

An installation set is available for starting up the system for the first time.

This installation set includes:

- the programming software BTPROWIN
- the PLC driver AEG12xxx.btg
- one connecting cable for PC - BT1000 (KB 3++)
- one connecting cable for A120/A250 - BT1000 (KB047)

Connecting cable:

Data Transfer BT1000 <-> PLC

The data transfer is accomplished in flag words. When parameterizing RD_PLC and WR_PLC as well as the variables, it must be ensured that the flag words that are used have been programmed in the PLC. Address range for variables: MW 1 ... MW 9999

Address range for RD_PLC/WR_PLC: MW 1 ... MW 9980

System message 27 is activated if error messages from the PLC occur.
The error number transmitted by the PLC is entered in the filler characters.

Error 06 : Out-of-Range (the requested data can not be accessed in the PLC.)

4.2 Allen-Bradley DF1

Order Designations

BT1000 Interface: PLC programming interface (RS232, TTY, RS422/485 & Programming Interface COM1: (RS232))

PLC Driver: AB_12xxx.btg

The RS232 interface (electrically isolated) is used.

Settings for Channel 0 (SLC-5/xx, PLC-5/xx):

PLC Address: 31 decimal or 77 octal

Baud Rate: 19,2kBaud

Stop Bits: 2

Control Line: NO Handshake

Duplicate detect: On

ACK Timeout: 10

MSG appl timeout: 1

Parity: Even

Error Detect: CRC

Nak Receive: 5

DF1 ENQ: 5

Installation Set:

An installation set is available for starting up the system for the first time.

This installation set includes:

- the programming software BTPROWIN
- the PLC driver AB_12xxx.btg
- one connecting cable for PC - BT1000 (KB 3++)
- one connecting cable for SLC 5/03 - BT1000 (KBxxx)
- one connecting cable for PLC 5/30 - BT1000 (KBxxx)

Connecting cable:

Data Transfer BT1000 <-> PLC

The data transfer is accomplished in register ... 255

Variable address range: Register 0 ... 255
Address range for RD_PLC/WR_PLC: Register 0 ... 255

PLC 5:

The Files N 7 ... N 99 can be used. In the files, registers r0 ... r255 can be addressed (NN:rrr). N9 is automatically used (default) if no file is specified.

SLC 500:

A file no. specification will be ignored. N9 is always used (default).

Message 27 is activated if error messages from the PLC occur. The error number transmitted by the PLC is entered in the filler characters.

10 : Invalid command or format (PLC operating mode or settings in CH0 incorrect)
50 : Illegal addressing (file for the communications word range not large enough)
80: Illegal addressing (no file for the communications word range)

For further details see "Chap. 4.1 Status Code of the Asynchronous Interconnection"

4.3 MODBUS RTU

Order Designations

BT1000 Interface: PLC programming interface (RS232, TTY, RS422/485 & Programming Interface COM1: (RS232))

PLC Driver: MB_12xxx.btg

The RS232 interface (electrically isolated) is used.

Interface Setting:

Baud Rates: 4800Baud / 9600Baud / 19,2kBaud / 38,4kBaud

Parity: even / odd / none

Installation Set:

An installation set is available for starting up the system for the first time.

This installation set includes:

- the programming software BTPROWIN
- the PLC driver MB_12xxx.btg
- one connecting cable for PC - BT1000 (KB 3++)
- one connecting cable for Modicon 984 - BT1000 (KB054)

Connecting cable:

BT 15 is Modbus master. The operating system is designed for communication with precisely one slave. The network address is programmed in the system set-up function of BTPROWIN.

Data Transfer BT1000 <-> PLC

The data transfer is accomplished in register 40001 ... 49999 in accordance with the variable address 1 ... 9999. With this type of interface connection, the offset of 40000 must be taken into consideration. Only those variable which are available in the PLC may be addressed.

Variable address range: 1 ... 9999
Address range for RD_PLC/ WR_PLC: 1 ... 9980

Message 27 is activated if error messages from the PLC occur. The error number transmitted by the PLC is entered in the filler characters.

01	: Illegal Function
02	: Illegal Data Address
03	: Illegal Data Value
04	: Slave Device Error
05	: Acknowledge (Processing time required by slave is too long)
06	: Slave Busy
07	: Negative Acknowledge
08	: Memory Parity Error
080..082	: Internal Error Number

4.4 MODBUS+ via Gateway

Error Messages:

The following error messages may be shown on the operator panel's display:

10h	MB+ "in Monitor Link Operation"	OFFLINE (Log on to MB+)
11h	MB+ "Never getting Token"	Can not obtain token
12h	MB+ in "Sole Station"	No further stations exists
13h	MB+ in "Duplicate Station"	Station with identical address exists
14h	MB+ "Routine Failed"	Target station can not be addressed

Functions of the Diagnostic LED

H1 lights up while a request is being processed in MB+ (flickers during normal operation)

H2 currently only after start-up - display of version number
(up to 1st request to MB+) flashes 1 time; long pause ==> Vers 1

H3 MB+ Status

1 blink 160ms pause	> Normal operation no error
1 blink 1s pause	> OFFLINE (Log-on to MB+)
2 blinks 2s pause	> Can not obtain Token
3 blinks 1,7s pause	> No further station exists
4 blinks 1,4s pause	> Station with identical address exists

4.5 Siemens S5 via L1

Interface hardware: the 20mA interface is used.

Connecting cable:

Interface Setting: 9600 Baud/ 8 Bit PE

PLC Driver: L1_12xxx.btg

Data Transfer BT1000 - PLC

Data is transferred in the form of data words. When parameterizing RD_PLC, WR_PLC and the variables, make sure that the data blocks used in the PLC are large enough. No checks are carried out at operating time in order to avoid affecting the speed. Addressing data words which do not exist can result in the signal latch being changed in an uncontrolled manner. If no data block number is specified during address specification, BT1000 automatically accesses data block 7.

Initializing communication: depending on the PLC type, communication is initiated either via FB30 or via the settings in DB1. FB30 must be called in the start-up blocks OB21 and OB22. In certain PLCs, the L1 functions are initialized in DB1. In these cases, an appropriate DB1 must be integrated in the program.

Assigned flags: - MB100- MB101

Assigned data blocks:- DB2 (SF)- DB3 (EF)- DB7 (default DB)

The data handling block FB31 must be called at cyclic intervals, e.g. in OB1.

Example: Data handling block for S5-95U

```
0000           :
0001           : SPA FB31   BT DATA HANDLING BLOCK
0002 NAME     : BT-KOP95
0003           : ***
```

Program file-CPU assignments

```
95U           - BT95U@ST.S5D
100U CPU 103  - BT103UST.S5D
115U CPU 941 to 944 - BT115UST.S5D
115U CPU 945  - BT945@ST.S5D
```

The program files listed contain the following data blocks:

DB1, DB2, DB3, DB7, FB30, FB31, OB1, OB21, OB22. DB7 contains the variables. The OBs only contain the entries which are necessary for operating the panels. The data blocks must be created in the RAM of the PLC.

4.6 Siemens S5 115U .. 155U via SAS525

We offer the interface cards SAS525 -16 and SAS525 -CL for series S5 115U .. S5 155U controllers. Depending on the volume of data to be transferred between the PLC and operator panel, up to 16 devices can be connected to one interface card. Mixed operation with BT1000 and other operator panels manufactured by EBELT are possible.

Data transfer principle

All data between the interface card SAS525-16 and the operator panels is transferred serially via a two-wire cable (RS485). Transmission securing is byte by byte by means of a parity check and block by block via a BCC. Any transmission errors are acknowledged automatically, i.e. a fault is suppressed by the telegram being repeated and is not noticed by the user unless it occurs continuously.

Order designations

Interface card:	SAS525-16 (with RS485 module) SAS525-CL (with 20mA module)
BT 15:	with standard interface module
PLC driver:	SAS12xxx.btg

Installation set SAS525-16

An installation set is available for starting up the system for the first time. The installation set includes:

- the necessary data handling blocks for the PLC
- the programming software BTPROWIN
- the PLC driver SAS12xxx.btg
- one connecting cable for PC - BT 15
- one connecting cable for SAS525 - BT 15

The installation set is only required once when the system is started up for the first time. Connecting cables can be cut to length and terminated in accordance with your requirements.

Structure of the interface card

The interface card SAS525-16 is a double-eurocard-size printed-circuit board with two 48-way base connectors in the ES902 rack system. The mounting depth is 1 1/3 standard slots. A 25-way min. D female connector for the RS485 interface is located at the front.

The interface card is powered via the PLC power supply unit (+5V). The current consumption is approx. 500mA.

Setting addresses with the DIL switches

DIL switches S1 and S2 are used to set the base address via which the module can be addressed by the programmable logic controller. This address depends only on the settings of these DIL switches and not on the slot in the PLC. The module can be set in two modes.

Absolute address:

In this mode, the base address of the module can be set to any address within the address space of the programmable logic controller. This address must be a multiple of four for the module SAS 525-xx. The module occupies four addresses from the set base address onwards. In order to be able to set the address, however, the selected address space must not already be occupied by the RAM or by other modules.

I/O address:

The interface module SAS 525-xx can also be integrated in an expansion rack. The EG switch on DIL switch S2 must be set to ON for this purpose. All addresses in the I/O range which do not run via the process image can be used. The I/O bytes PY0 to PY127 cannot, therefore, be used. The reason for this is that these I/O addresses are read and written cyclically via the PLC operating system in order to update the process image. If no interface module is used in AG 115U, the interface module (IM) SAS 525-16 can also be used instead of the terminating resistor connector in the interface slot. The terminating resistor connector is simulated via the module. Switches IM and EG of DIL switch S2 must be set to ON for this purpose. If the module is not used in the IM slot, it is extremely important that the IM switch of DIL switch S1 is set to OFF otherwise the 24V power supply may short circuit. Fuse F1 on the printed-circuit board, however, prevents any major damage being caused.

The following examples illustrate how addresses are set with DIL switches S1 and S2.

Example 1:

The module is to be used in the expansion rack. The base address of the module is to be set to PY140(=8Ch).

Example 2:

The module is to be addressed in the central rack via the base address F100h.

Example 3:

The module is to be inserted in the IM slot in the central rack of AG115U and addressed via the base address PY232(=F0E8h).

Position of the DIL switches on the interface module

Allocation table absolute address, I/O address and switch settings of the DIL switch S2:

absolute address	I/O address	A7	A6	A5	A4	A3	A2
F080	PY128	1	0	0	0	0	0
F084	PY132	1	0	0	0	0	1
F088	PY136	1	0	0	0	1	0
F08C	PY140	1	0	0	0	1	1
F090	PY144	1	0	0	1	0	0
F094	PY148	1	0	0	1	0	1
F098	PY152	1	0	0	1	1	0
F09C	PY156	1	0	0	1	1	1
F0A0	PY160	1	0	1	0	0	0
F0A4	PY164	1	0	1	0	0	1
F0A8	PY168	1	0	1	0	1	0
F0AC	PY172	1	0	1	0	1	1
F0B0	PY176	1	0	1	1	0	0
F0B4	PY180	1	0	1	1	0	1
F0B8	PY184	1	0	1	1	1	0
F0BC	PY188	1	0	1	1	1	1
F0C0	PY192	1	1	0	0	0	0
F0C4	PY196	1	1	0	0	0	1
F0C8	PY200	1	1	0	0	1	0
F0CC	PY204	1	1	0	0	1	1
F0D0	PY208	1	1	0	1	0	0
F0D4	PY212	1	1	0	1	0	1
F0D8	PY216	1	1	0	1	1	0
F0DC	PY220	1	1	0	1	1	1
F0E0	PY224	1	1	1	0	0	0
F0E4	PY228	1	1	1	0	0	1
F0E8	PY232	1	1	1	0	1	0
F0EC	PY236	1	1	1	0	1	1
F0F0	PY240	1	1	1	1	0	0
F0F4	PY244	1	1	1	1	0	1
F0F8	PY248	1	1	1	1	1	0
F0FC	PY252	1	1	1	1	1	1

Plug-in jumpers X3 and X6 are irrelevant for this application.
Plug-in jumper X1 must remain set to "S".

Slots in AG 115U

Slots in AG 135U

Slots in AG 155U



Routing wires between BT1000 and SAS525

The RS485 interface is non-isolated on the interface card and electrically isolated at the individual operator panels. The shield is connected to the shield of the PLC via pin 1 of the interface card and should not be grounded a second time. The entire surface of the interface connector housing must be connected to the shield (use metal casing)..

Technical specifications for interface card SAS 525-16

Interface:	RS 485, electrically connected
Cable connector:	25-way SUB-D female connector
Transmission rate:	38400 Baud
Max. cable length:	1200m (shielded, twisted)
Current consumption:	Approx. 500mA

Technical specifications for interface card SAS 525-CL

Interface:	20mA, passive, electrically isolated
Cable connector:	25-way SUB-D female connector
Transmission rate:	38400 Baud
Max. cable length:	400m (shielded, twisted)
Current consumption:	Approx. 500mA

Only one operator panel can be connected if a 20mA interface is used

The installation set includes a disk with the following files:

SAS115ST.S5D	for 115U
CPU945ST.S5D	for 115U CPU945
SAS135ST.S5D	for 135U
SAS155ST.S5D	for 155U

Procedure parameterization with the block KONF64-E (FB 201)

This block is used for module and procedure initialization and must be called after a power failure and after the module has been plugged in. The following parameter list is output after FB 201 is called:

DBHB

Data block for storing internal data of the selected data channel. The data block must be at least 30 words long.

ADR

This is used to enter the base address to which the module is set. This base address can be set with DIL switches S1 and S2.

DBVR

This is used to enter the data block which is to be valid for handling variables if the variable address is specified without a DB number when text is generated on the operator panel.

Passive data handling block (FB195)

Block FB195 establishes the connection between SAS 525-xx and the S5 program. The block must be called at least once in a cycle. In the case of longer PLC cycle times, FB195 can be called several times (every 30ms). The response time is thus shortened. The block requires a data block with a minimum length of 30 words for managing the internal data. The data block specified here must be the same as that for FB 201 (KONF64-E).

Auxiliary blocks FB198/199

These blocks must be loaded in the PLC. They contain internal auxiliary routines and are called by the data handling block (FB195). The auxiliary blocks cannot be listed.

Error messages

If an error occurs, the interface card SAS 525-xx should be started up in precisely the specified sequence.

The following errors can occur:

- Incorrect channel number
- Data block (HTDB) for internal data does not exist or is too short.
- Interface card hardware error
- Incorrect wiring
- Operator panel programmed incorrectly
- Hardware address assigned twice (with other modules)

The errors that can occur are indicated on the connected operator panels:

BT 15 <— > SAS 525-xx connection

The operator panel outputs the following message if no connection is established between SAS 525 and BT1000:

System message 21 "No communication set-up with PLC"

This error can have the following causes:

- No voltage (power supply unit of the PLC on!) on the interface card
- Wiring between SAS 525-16 and BT1000 is incorrect (this is often the cause)
- Interface hardware defect on the card or operator panel (unlikely)
- There is no driver or there is an incorrect driver loaded in BT1000

In cases of doubt, only connect one operator panel! No further error diagnostics can be carried out until this error message has been removed. It is, therefore, important to remove the error message before proceeding. In order to remove the error message, simply make sure that the power supply for the interface card and BT1000 is present and that the connecting cable has been plugged in correctly. The PLC may still be in the STOP mode. It is not necessary to load a PLC program.

Connection between SAS 525-16 and PLC

The following error message can appear if the external setup is in order and the system is functioning correctly:

System message 29 No communication set-up with PLC
 Type: _____
 Number of filler characters in text: 24

This error message can have the following causes:

- PLC is not in the RUN mode
- The data handling block is not called cyclically
- FB201 is not called in the start-up blocks (OBs)
- The hardware address has been assigned twice

3964 procedure error

27 PLC reports error number: _____ in _____
 Number of filler characters in text: 4/12

Out of all the procedure errors, only error 14h (19decimal) is relevant. In practice, the error occurs in DB 99 (too small or does not exist) or in one of the variable DBs which is set in DW0 of DB99 or in the variable definition or which is parameterized in FB201. The DB specified here should exist and be of a sufficient enough size.

Parameterization errors in the connected operator panels

The following error messages, which can be caused by parameterization errors in the connected operator panels, are possible:

24 Incorrect response from ST:
 Number of filler characters in text: 2

The station specified in the variable field responds continuously with incorrect telegrams. Possible causes are that the station numbers have been assigned twice, a hardware defect has occurred in the station in question or an unsuitable software release in the station in question.

25 BUS TEST MODE:
 Number of filler characters in text: 24

The interface card SAS525-16 is in the bus test mode. Messages from the interface card are output in the variable field in the display. The messages can be scrolled using the arrow keys of station 1. Station 1 must, however, have been recognized by the interface card for this purpose.

26 ST:___ reports unknown function
 Number of filler characters in text: 2

The function requested by the station is not supported by the interface card. Remedy: plug an EPROM with a new software release into the interface card.

28 Read block too large__ DW from DW_ max. DW _____
 Number of filler characters in text: 3/5/5

The largest data word to be read from DB99 is larger than DW175.

Flags and data blocks used

Data block 99 is used to connect the operator panels to the PLC and must be of a sufficient enough size. The two other data blocks (data block for variables and data block for data handling blocks) are freely selectable. Flag bytes 230 to 255 are used as scratch flags.

BT 15 - PLC connection

The BEST-PLC connection consists of 2 parts:

1. Contacts:

This includes all single-bit information such as function keys, LEDs, control words and life bits of the operator panels. RD_PLC and WR_PLC are in DB 99.

2. Variable data:

Variables are numbers from data blocks of the PLC which can be represented in various number formats in the fixed text of the display. Variables from any data block can be addressed. The data blocks must exist and must be of a sufficient enough size.

Data block for contacts (DB 99)

DB 99 has been permanently assigned for connecting the operator panel to the PLC. Data word DW0 is used to specify the data block in which variables are stored without a DB number. It is important to make sure that the specified block exists and that it is of a sufficient enough size. Impermissible accesses are reported as errors by the interface.

All other data words are intended for the keys, LEDs and message numbers of the connected operator panels.

The data words for RD_PLC should, as far as possible, be programmed contiguously for all stations. The highest data word number for RD_PLC is 175 (with several stations).

The higher data words should be used for programming the keys. The RD_PLC range should be assigned contiguously in order to optimize the operating time for several operator panels.

Life bits

A word with 16 life bits is inserted at WR_PLC+4 for the operator panel with the station number 1 (TN 01). Each bit in this data word represents one of 16 possible connected operator panels. The PLC is informed here of the operator panels which are active in the network. This data word is written cyclically by the interface card SAS 525-16 and is used to monitor the interface card to ensure that it functions correctly in conjunction with the operator panel network.

This data word must be deleted in the start-up block. A situation could occur in which station 1 is permanently defective or has not been programmed. The interface card is then not able to determine the data word. An old set of contents must, therefore, be deleted.

Data block for variables

The variables defined in the programming software BTPROWIN can be specified either with or without the numbers of the data blocks used. If the data block number is omitted, the data block whose number is specified in DW0 of DB 99 is used. It is important to make sure that the specified block exists and that it is of a sufficient enough size. Impermissible accesses are reported as errors and are output on the display of the operator panel.

It is advisable to use the complete definition for global variables whereas the part definition should be reserved for local variables (i.e. those which are only available in the active FB). Adequate support is thus provided for structured programming.

Data blocks DB0 and DB1 must not be used because of the special status they have for the PLC. The interface card SAS525-xx uses the data block specified in DB99:DW0 instead.



4.7 Mitsubishi FX / FX0

Order Designation

BT1000 Interface: PLC programming interface (RS232, TTY, RS422/485 & Programming interface COM1: (RS232))

PLC Driver: MIT_12xxx.btg

The RS422 interface (electrically isolated) is used.

Interface Setting:

Baud Rate: 9600 Baud/ 7 Bit/ PE

Installation Set:

An installation set is available for starting up the system for the first time.

This installation set includes:

- the programming software BTPROWIN
- the PLC driver MIT12xxx.btg
- one connecting cable for PC - BT1000 (KB 3++)
- one connecting cable for (KB040)
- one connecting cable for (KB041)

Connecting cable:

Data Transfer BT1000 <-> PLC

The parameterization is performed in the programming software.

The variable addresses are specified in the programming software as a number without identifier. Bit flags M0 ... M1023 are also addressed in word-mode.

Example:

Variable 3000 => M0 ... M15
Variable 3063 => M1008 ... M1023

The following assignment applies:

Variable 0 ... 999	D0 ... D999
Variable 1000 ... 1999	D1000 ... D1999
Variable 2000 ... 2199	C0 ... C199
Variable 2200 ... 2255	C200 ... C255
Variable 3000 ... 3095	M0 ... M1535
Variable 4000 ... 4255	T0 ... T255
Variable 8000 ... 8255	D8000 ... D8255

PG-MUX:

The FX (25-way connector) requires a jumper between pin 20 and pin 21 for the PG-MUX function. This jumper allows the program memory of the PLC to be written to. If this function is not required, the jumper should be removed for safety reasons in order to avoid accidental or unauthorized program modifications. In addition, the file registers D1000 ... D1999 can not be used without a jumper in the connector. When the PG-MUX is used and the memory allocation in the PLC is modified, the BT1000 should perform a restart to cause the memory configuration to be reread from the PLC. If the starting addresses are outside of the ranges, system message 8 with error number 1 is activated.

4.8 Klöckner - Moeller Suconet K1

Order Designations

BT1000 Interface: PLC programming interface (RS232, TTY, RS422/485 & Programming interface COM1: (RS232))
The RS485 interface (electrically isolated) is used.

PLC Driver: K1_12xxx.btg

Interface Setting:
Baud Rate: 187kBaude

Installation Set:

An installation set is available for starting up the system for the first time.
This installation set includes:

- the programming software BTPROWIN
- the PLC driver K1_12xxx.btg
- the data handling block BT100E
- one connecting cable for PC - BT1000 (KB 3++)
- one connecting cable for Suconet - K1 - BT1000 (KB051)

Connecting cable:

Data Transfer BT1000 <-> PLC

The BT100E driver is called in the PLC at cyclic intervals. The driver is responsible for writing the data exchanged via the K1 bus to and reading them from the flag words addressed by the BT1000. The auxiliary flags being employed can not be used in the user program. There are no further restrictions.

The data transfer is word-oriented. Therefore, only even word addresses are used in the BT1000. The entire available flag word area can be used.

4.9 InterBus-S

Interface hardware: The IBS interface card is installed in the BT 15 in place of the universal interface card. For the connection to the bus, electrically isolated RS485 drivers are used. The actual bus protocol is handled by the ASIC SUPI-III InterBus-S protocol.

A PLC-manufacturer-specific InterBus-S master module which is preferably electrically isolated is required on the controller side. If the master module in the controller is equipped with an 8-wire remote bus interface, the bus can be converted to a 2-wire remote bus with the bus terminal IBS 24 BK/LC2.

A data handling block is called in the main program of the controller. This data handling block is parameterized with the locations of the IN and OUT addresses. This data handling block is executed cyclically at least once for each operator panel connected. The data handling block addresses the variables in the data blocks of the PLC. All requests are made from the operator panel which means that programming can be carried out independently of the bus system (Profibus DP, L1, SAS, Modbus).

BT1000 is integrated in the 2-wire remote bus of the InterBus-S as a slave. The interface module occupies a data width of 4 words (8 bytes) on the InterBus-S. In the controller, each operator panel is represented by means of 8-byte IN data and 8-byte OUT data in the I/O image.

A data handling block is available for S5 -115U/CPU945B and S5 -115U/CPU943B. If required, the data handling blocks can be adjusted to suit other CPUs.

Parameters:

Data Channel Width: 4 Words / 8 Bytes
Identcode: 03h (digital remote bus station)

Diagnostic LEDs

US

The green US LED lights up as soon as the InterBus-S logic is supplied with 5V.

RC

The green RC (Remote Bus Check) diagnostic LED is used to monitor the incoming remote bus cable. The LED lights up if the cable connection is functioning properly and the IB master is not in the reset mode. During an InterBus-S reset or power-up reset, the LED is inactive.

BA

The green BA (bus active) LED indicates that an InterBus-S transmission is taking place. The LED has an off delay which is equal to the selected IB-Watchdog time (640ms).

RDBA

The red RDBA LED indicates the disablement of the outgoing remote bus.

InterBus-S Remote Bus - Pin Assignment and Cable:

	Remote Bus In	Remote Bus Out
1	DO	DO
2	DI	DI
3	GND	GND
4	-	-
5	-	+ 5V
6	/DO	/DO
7	/DI	/DI
8	-	-
9	-	RBST

Cable Type: LI-YCY- 3 x 2 x 0.25 mm²
twisted pair wires
both ends of the common shield must be connected to the connector housing
Metallic casings or metallized connector housings must be used

4.10 Profibus DP

Interface Hardware:

The Profibus interface card with the L2DPMMI Bridge is installed in the BT1000 in place of the universal interface card. For the connection to the bus, electrically isolated RS485 drivers are used. The actual bus protocol is handled by the ASIC SPC-3 protocol.

A data handling block is called in the main program of the controller. This data handling block is parameterized with the locations of the IN and OUT addresses. The data handling block is executed cyclically at least once for each operator panel connected. The data handling block addresses the variables in the data blocks of the PLC. All requests are made from the operator panel which means that programming can be carried out independently of the bus system (Interbus-S, L1, SAS, Modbus).

Data handling blocks are available for the Siemens S7-300. For other makes, a data handling block can be produced on request.

Ident-Number (ID) for Profibus-DP Devices in Compliance with DIN E19245 Part 3

Device designation: L2DP MMI Bridge
 Ident Number: 0538 HEX
 GSD: EBLT0538.GSD

Transmission Rate:

The baud rate is specified in the DP-Master. BT1000 operator panels with the L2DPMMI bridge accept the following baud rates: 9,6kBaud ; 19,2kBaud; 45,45kBaud; 93,75kBaud; 187,5kBaud; 500kBaud; 1,5MBaud; 3MBaud; 6MBaud; 12Mbaud. The baud rate is detected automatically; a parameterization is not required.

Diagnostic LED

The green LED lights up as soon as the bus logic is supplied with 5V.

The yellow LED indicates a bus error.

The red LED reports a system error on the interface card.

Pin Assignment

1	Unassigned
2	Unassigned
3	B-wire
4	Request to Send (RTS)
5	Ground 5V
6	Potential 5V
7	Unassigned
8	A-wire
9	Unassigned

The shield must be connected with the metallized connector housing.

Please note carefully:

The A and B wire in the connector are designated in accordance with the RS485 standard, not the pin designation of the driver ICs.

Please note:

In accordance with the Profibus standards, terminating resistors must be installed into the bus connector at the end of the bus cable. The pins (ground 5V) and (potential 5V) are used for this purpose.

5. System Messages

Message:1

Suggested text: Input too large! Maximum: _____
 Number of filler characters in the text: 11
 Explanation, further details:...

Message: 2

Suggested text: Input too small! Minimum: _____
 Number of filler characters in the text: 11
 Explanation, further details:...

Message: 5

Suggested text: Programming unit occupies PLC interface!
 Explanation, further details:
 This message is displayed if the
 (PLC) programming unit exclusively
 occupies the communications interface
 resulting in the BT 15 not being capable
 of establishing a connection.
 For example during the download of a program to the PLC....

Message:7

Suggested text: Access level not released

Message: 12

Suggested text: Set: __. __ __: __: __ Res: __: __: __ Duration:
 __: __: __

Please note: Filler characters should not be used. The internal variables I610xx should be used instead.

Explanation: Here, the header for fault messages in the diagnostic memory can be defined. The following internal variables can be used:

Message No.:	I61000	Point of time when message is	
acknowledged			
(Priority	I61001)	(s	I61015)
(Acknowledgement behavior	I61002)	(Min	I61016)
Point of time when message is set		(h	I61017)
s	I61003	(Day	I61018)
Min	I61004	(Month	I61019)
h	I61005	(Year	I61020)
Day	I61006	Duration of fault	
Month	I61007	h	I61021
Year	I61008	min	I61022
Point of time when message is reset		s	I61023
s	I61009		
Min	I61010		
h	I61011		
Day	I61012		
Month	I61013		
Year	I61014		

All variables listed above are represented in the UNS format. The variables in parenthesis are intended for future extensions.

Message: 16

Suggested text: Data record not compatible with operating system

Explanation, further details:

The data record contains elements that can not be used with the loaded operating system.

Remedy:

Select the appropriate driver in the programming software and load it together with the data record into the BT1000.

Message: 17

Suggested text: Illegal memory configuration

Explanation, further details:

Message: 18

Suggested text: End of diagnostic memory(most recent element)

Explanation, further details:

Identifier of the end of the diagnostic memory

Message: 19

Suggested text: End of diagnostic memory (oldest element)

Explanation, further details:

Identifier of the beginning of the diagnostic memory

Message: 20

Suggested text: Power supply interruption

Explanation, further details:

If the power supply to the BT1000 is interrupted the point of time when the power supply is interrupted and resumed is entered into the diagnostic memory.....

Message: 21

Suggested text: No connection to PLC! Please check cable

Explanation, further details:

This message is displayed if the connection to the PLC is permanently disrupted.....

Message: 22

Suggested text: PLC not in RUN-MODE

Explanation, further details:...

Message: 24

Suggested text: Incorrect response from ST:___

Number of filler characters in the text:2

Explanation, further details:

A station on the network whose number is entered into the filler characters continuously provides incorrect responses to telegrams. This indicates that the versions of the devices are incompatible or that 2 devices on the network have the same station no. and therefore interfere with each others response telegrams.

Message: 25

Suggested text:

BUS-TEST-

MODE: _____

Number of filler characters in the text:24

Explanation, further details:...

Message: 26

Suggested text: ST: __ signals unknown function
Number of filler characters in the text:2
Explanation, further details:
SAS card version is not compatible with selected driver.

Message: 27

Suggested text: PLC signals error no.: ____
concerning_____
Number of filler characters in the text:4/12
Explanation, further details:
The meaning of this error number is PLC-specific.
For an explanation see PLC documentation.

Message: 28

Suggested text: Read block too large__ DW as of DW __
max. DW ____
Number of filler characters in the text: 3/5/5
Explanation, further details:
The maximum block size for the SAS525
interface module is exceeded....

Message: 29

Suggested text: No communication set-up with PLC
Type: _____
Number of filler characters in the text: 24
Explanation, further details:
A connection to the PLC is established
however, there is no logic communication.
The SAS card version no appears in the
filler characters....

Message: 30

Suggested text: Access attempt outside of valid range
to:_____ Cycle Identifier:_
Number of filler characters in the text: 10/1
Explanation, further details:...

Message: 31

Suggested text: Access attempt outside of valid range
by indexed variable to:_____ Cycle Identifier:_
Number of filler characters in the text: 10/1
Explanation, further details:

6. Internal Variables

Internal variables are variables which are not read from the PLC, but are allocated a fixed meaning in the BT1000. The following internal variables are available in addition to the internal variables described in conjunction with system message 12.

Clock s		BCD	I60000	
Clock min		BCD	I60001	
Clock h		BCD	I60002	
Clock Weekday		BCD	I60003	(0..6 = Sunday .. Saturday)
Clock Day		BCD	I60004	
Clock Month		BCD	I60005	
Clock Year		BCD	I60006	
PLC Communication Error		UNS	I60011	
PLC Communication Cycles		UNS	I60012	
System Switch 13		I60013		
		Bit 0		Setting of contrast
		Bit 1		Language Switching
				0= 1st Language 1= 2nd Language
		Bit 2		0=Always Display Fault Message Window for current Faults
				1=always suppress Fault Message Window For Extensions
System Switch 14		Bit 3..15		
		I60014		
		Bit 0		
		Bit 1		Display current Messages in the Diagnostic
	Memory	Bit 2		Display all Messages in the Diagnostic Memory
System Switch 15		I60015		
		Bit 0..1		PG-Mux, if available for driver
				0 = Off, 1 = PG-MUX,
				2 =Continuous Connection of PLC - Programming
Unit				

7. PROGRAMMABLE APPLICATION INTERFACE PAI V1.0

Please note:

The programming tool for PAI is optional. If the PAI is used, the BT1000 requires memory expansion. Without PAI, the BT1000 is controlled by the PLC.

The Programmable Application Interface PAI has been developed to relieve the PLC of any OPERATOR CONTROL & MONITORING tasks.

This reduces the exchange of data from and to the PLC to the exchange of status and command information. Key functions of the PAI are:

- Process inputs via keyboard
- Process inputs via external peripherals such as card reader, bar code reader, scales, etc.
- Visualize machine states, error messages
- Link key commands based on machine states
- Provide data records (parameters) for PLC
- Provide data records for external peripherals
- Output MDA and PDA to printer or host computer

These tasks are usually closely linked to the MAN-MACHINE-INTERFACE. It is therefore, advisable to program this accordingly in the operator panel. The commands of the PAI are specifically tailored to these tasks and can thus be used effectively and in a straightforward manner. The amount of work involved in solving the same tasks in the PLC would be disproportionately high. An expensive communications processor is, therefore, not necessary in many cases.

7.1. Memory Allocation between BT and PAI

The free RAM is divided into three areas in the programming software BTPROWIN:

1. Diagnostic memory for fault messages
2. Recipe memory (Array A for PAI)
3. Memory for PAI workspace (PAI RAM)

In addition, a fixed memory area of 100 words is available for the data transfer between the PAI and BT area in the BT1000.

The memory capacity is specified in bytes while the allocation of the memory is performed in words (2 bytes).

The PAI is capable of directly accessing 3 memory areas:

- Array A (recipe memory configurable in BTPROWIN)
- PAI working memory (maximum size configurable in BTPROWIN)
- BT transfer memory (100 words)

7.1.1 BT Area

The BT area comprises 100 words which are addressed by the PAI as BT0 ... BT99. (The BT addresses them as internal variables i60000 .. i60099). Their function is fixed.

7.2. Communication with the PLC

The communication with the PLC takes place at three levels:

- 1. Cyclic data exchange
- 2. Reading and writing of variables that were defined in message windows and menus
- 3. Program-controlled reading and writing of data (PAI).

7.2.1 Cyclic Data Exchange with the PLC

The PLC addresses WR_PLC and RD_PLD are defined in the programming software BTPROWIN. If an operator panel is connected without PAI, these data blocks have a fixed function (see operator panel manual for description). If the PAI is used, the function of the data can be redefined as desired.

WR_PLC

The length of the WR_PLC data block (data which are written to the PLC at cyclic intervals) is defined in BT word address BT30. The data block to be transmitted starts from BT word address BT90. In order for the transmission to be performed, changes must have occurred since the previous transmission. The PLC driver performs the check process automatically. The write address in the PLC is defined in the programming software BTPROWIN.

RD_PLC

The RD_PLC data block is read from the PLC at cyclic intervals and stored in the BT word addresses from address BT70 onwards. The length is defined by the PAI program in BT word address BT30. Flag BT60.0 signals the receipt of an RD_PLC data block. The read address in the PLC is defined in the programming software BTPROWIN.

7.2.2 Reading and Writing Variables

Variables are automatically requested from the PLC once they are required on the display. If input variables are written to the PLC, the flag "data transfer in progress" will signal that this process is taking place.

7.2.3 Program-Controlled Reading and Writing of Data (PAI).

A program-controlled transfer of data to the PLC can be performed for data from the PAI address range and the defined arrays. See section 7.1.2

7.3 PAI Program

The PAI programming language features powerful commands specifically tailored to the requirements of a Man-Machine-Interface (MMI), thereby ideally complementing the PLC.

7.3.1 Language Elements

The individual language elements comprise commands, labels, parameters and comments.

Comments

Comment character is the ";" character. Everything following this character up to the end of the line is treated as a comment.

Labels

A label is a specific position in the program which, for example, can be jumped to or from which onwards constants are stored. A label must be positioned at the beginning of a line, must be concluded with a colon and has a maximum length of 32 characters. Numbers are not permitted in label names.

Labels with fixed definitions (reserved names)

Project:[project name];the project name is entered here

INIT: ;this label precedes all commands, which follow the initialization.
 ;The part of the program preceded by this label is
 ;executed only once after BT start-up.

LOOP: ;indicates the beginning of the main program which is executed
 ;at cyclic intervals.

Commands

The syntax of commands is as follows:

Command name <(parameter, parameter,..)> <{further commands}>

Certain commands consist of the command name only (e.g. RET). Some commands comprise a block with additional commands enclosed between {} which are executed only if the condition is satisfied (IF..).

Word Parameters

The following parameters are possible

PAI 0...n ;PAI RAM (0...3000)

BT0..99 ;BT functions according to the appendix

A ..n ;Array according to definition
 ;l = Index; 1..n = entries according to index

nn ;Constant parameter decimal

nnh ;Constant parameter hexadecimal (the first character must be a number
 ;e.g. 0FFFh)

nnnbn ;Constant parameter binary

Bit Parameters

All word parameters except constants with the extension ".B" are possible, with B being the bit position 0..15.

e.g. PAI17.3 ;Bit 3 in PAI word address 17

7.4 Structure of a PAI Program

The PAI program consists of 3 parts:

- Project name
- Initialization
- Main program (LOOP)

Project Name

The project name appears at the beginning of the PAI program and begins with the label "Project:"

Example:

Project: ["Testprogramm",0]

Note: The name ["DEMO",0] is reserved for all BT1000 drivers

Initialization

The initialization starts with the label "INIT:" and is executed one time immediately after the PAI code has been successfully verified. There is no time monitoring. The time required for the execution of the routine can not, however, exceed the watchdog-time (approx. 300ms). The function must be concluded with the command RET(). The "GOTO" command can not be used during the initialization.

Main Program (LOOP)

The main program starts with the label "LOOP:" and is executed at cyclical intervals. This function must be concluded with the command "RET ()". The execution time is limited to 300ms.

7.5. Commands

7.5.1 "LoadWord", "LW"

Syntax: LW (dst, scr)
 <dst> Target word address (PAI n, BT n, Array n)
 <scr> Source N (PAI n, BT n, Array n, Constant)

Explanation: Loads the contents from word <scr> to the word<dst> (unconditional assignment)

7.5.2 "IFx"

Syntax: IFx (scr1, scr2) [{...}]
 p =,<,>,>=,<=,<> Type of comparison
 <scr1> Source word address or bit address
 (PAI n, BT n, Array n, Constant)
 <scr2> Source word address or bit address
 (PAI n, BT n, Array n, Constant)

Explanation: Compares <scr1> and <scr2> if the comparison proves to be "true", the commands of the block in {}or the following command are executed.

7.5.3 "INC"

Syntax: INC (dst, scr1, scr2)

<dst> the word to be incremented (PAI n, BT n, Array n)
 <scr1> the lower limit, permitted is: (BT n, PAI n, Constant)
 <scr2> the upper limit (BT n, PAI n, Constant)

Explanation: increments <dst>. If the upper limit is exceeded after the incrementation (<scr2>), <dst> is set to the lower limit (<scr1>).

7.5.4 "DEC"

Syntax: DEC (dst, scr1, scr2)

<dst> the word to be decremented (PAI n, BT n, Array n)
 <scr1> the lower limit (BT n, PAI n, Constant)
 <scr2> the upper limit (BT n, PAI n, Constant)

Explanation: decrements <dst>. If the word falls below the lower limit after the decrementation (<scr1>), <dst> is set to the upper limit (<scr2>).

7.5.5 "AND"

Syntax: AND (dst, scr1, scr2)

<dst> Target word address, bit address (PAI n, BT n, Array_n)
 <scr1> Source word address, bit address (BT n, PAI n, Constant)
 <scr2> Source word address, bit address (BT n, PAI n, Constant)

Explanation: <dst> = <scr1> & <scr2>

7.5.6 "OR"

Syntax: OR (dst, scr1, scr2)

<dst> Target word address, bit address (PAI n, BT n, Array_n)
 <scr1> Source word address, bit address (BT n, PAI n, Constant)
 <scr2> Source word address, bit address (BT n, PAI n, Constant)

Explanation: <dst> = <scr1> or <scr2>

7.5.7 "SUB"

Syntax: SUB (dst, scr1, scr2)

<dst> Target word address (PAI n, BT n, Array n)
 <scr1> Source word address (BT n, PAI n, Constant)
 <scr2> Source word address (BT n, PAI n, Constant)

Explanation: <dst> = <scr2> - <scr1>

7.5.8 "ADD"

Syntax: ADD (dst, scr1, scr2)

<dst> Target word address	(PAI n, BT n, Array_n)
<scr1> Source word address	(BT n, PAI n, Constant)
<scr2> Source word address	(BT n, PAI n, Constant)

Explanation: <dst> = <scr1> + <scr2>

7.5.9 "LoadBit", "LB"

Syntax: LB (dst, scr)

<dst> Target bit address	(PAI n.b, BT n.b, Array n.b)
<scr> Source bit address	(PAI n.b, BT n.b, Array n.b)

Explanation: Loads <scr> into the <dst>

7.5.10 "SetBit", "SB"

Syntax: SB (dst)

<dst> Target bit address	(PAI n.b, BT n.b, Array n.b)
--------------------------	------------------------------

Explanation: Unconditional assignment of a "1" to the <dst>

7.5.11 "ResetBit", "RB"

Syntax: RB (dst)

<dst> Target bit address	(PAI n.b, BT n.b, Array n.b)
--------------------------	------------------------------

Explanation: Unconditional assignment of a "0" to the <dst>

7.5.12 "IFSET"

Syntax: IFSET (scr) [{...}]

<scr> Source bit address	(PAI n.b, BT n.b, Array n.b)
--------------------------	------------------------------

Explanation: If <scr> is "1", the commands of the block in {} or the following command are executed.

7.5.13 "IFRESET"

Syntax: IFRESET (scr) [{...}]

<scr> Source bit address	(PAI n.b, BT n.b, Array n.b)
--------------------------	------------------------------

Explanation: If <scr> is "0", the commands in the block in {} or the following command are executed.

7.5.14 "IFPLU"

Syntax: IFPLU (scr1,scr2) [{...}]

<scr1> Source bit address	(PAI n.b, BT n.b, Array n.b)
<scr2> Source bit address	((auxiliary bit) PAI n.b)

Explanation: If <scr1> has a modification from "0" to "1", the commands in the block in {} or the following command are executed. The auxiliary bit can not be used more than once.

7.5.15 "IFPLD"

Syntax: IFPLD (scr1,scr2) [{...}]
 <scr1> Source bit address (PAI n.b, BT n.b, Array n.b)
 <scr2> Source bit address ((auxiliary bit) PAI n.b)

Explanation: If <scr1> has a modification from "1" to "0", the commands in the block in {} or the following command are executed.

7.5.20 "RETURN", "RET"

Syntax: RET ()

Explanation: Concludes a function procedure call

7.5.21 "GOTO", "GO"

Syntax: GO (label)

Explanation: Jump to <label>

7.5.22 "COPY"

Syntax: COPY(dst,scr1,scr2)
 <dst> Target word address (PAI n, BT n, Array n)
 <scr1> Source word address (PAI n, BT n, Array n)
 <scr2> Number of words (PAI n, BT n, Constant)

Explanation: Copies the block (Length =<scr2>) from <scr1> to <dst>

7.5.23 "DEF"

Syntax: DEF(dst,scr1,scr2,scr3)
 <dst> The array, e.g. array B, array C, array D
 <scr1> Number of recipes (PAI n, BT n, Constant)
 <scr2> Number of words/recipe (PAI n, BT n, Constant)
 <scr3> Array starting address (PAI n)

7.5.24 "PLCTR"

Syntax: PLCTR(dst,scr1,scr2,scr3)
 <dst> Target word address (PAI n, BT n, Array n, PLC address)
 <scr1> Source word address (PAI n, BT n, Array n, PLC address)
 <scr2> Number of words (PAI n, BT n, Constant)
 <scr3> Coordination flag (bit address in PAI n, BT n)

7.5.25 "CANTR"

Syntax: CANTR(dst,scr1,scr2,scr3)
 <dst> Target word address (PAI n, BT n, Array n, CAN identifier)
 <scr1> Source word address (PAI n, BT n, Array n, CAN identifier)
 <scr2> Number of words (PAI n, BT n, Constant)
 <scr3> Coordination flag (bit address in PAI n, BT n)

8. PAI Compiler

The Programming software BTPROWIN comprises an editor which is used to create the PAI source program. The optional PAI software is required to activate this function. Compiling and loading is a separate function of the programming software. The compiler is composed of the actual compiler core and the compiler configuration file "TLCS.CFG". The "*.CFG" file is created in a processor-specific manner (in the operator panel) and contains information on commands and parameters that can be used.

8.1 Download and Integration

The binary file stored by the compiler is transferred to the BT by the BTPROWN programming system (Vers 2.5 and higher). In the BT1000 the data are stored in the flash memory. During a restart, the BT1000 verifies the PAI code for correctness (check sum). If an error is detected, the system stops and displays an error message.

9. BT / PAI Addresses

BT 0	i60000	Time s	BCD (read only)
BT 1	i60001	Time min	BCD (read only)
BT 2	i60002	Time Hr.	BCD (read only)
BT 3	i60003	Time Weekday	BCD (read only)
BT 4	i60004	Time Day	BCD (read only)
BT 5	i60005	Time Month	BCD (read only)
BT 6	i60006	Time Year	BCD (read only)
BT 7..10		PLC-specific settings according to interface module	
BT 11	i60011	Number of incorrect PLC cycles since reset	
BT 12	i60012	Number of initiated PLC cycles since previous reset	
BT 13	i60013	System switch	
BT 13.0	i60013.0	Setting of contrast	
BT 13.1	i60013.1	0= Language 1 / 1= Language 2	
BT 13.2	i60013.2	1= do not display fault messages in background graphics	
BT 14	i60014	current execution time of PAI program	
BT 15	i60015	Maximum execution time of PAI program	
BT16..BT19		Reserve	
BT 20	i60020	Control word	
	Bit 0 .. 3	Numerical keys	
BT 20.4	i60020.4	Shift key	
BT 20.5	i60020.5		
BT 20.6	i60020.6	Return key	
BT 20.7	i60020.7	Life bit	
BT 20.8	i60020.8	ESC key	
BT 20.9	i60020.9	Arrow left	
BT 20.10	i60020.10	Arrow right	
BT 20.11	i60020.11	Arrow up	
BT 20.12	i60020.12	Arrow down	
BT 20.15	i60020.15	Min. 1 fault message active	
BT 21	i60021	Bit 0 .. 9 / currently active menu element	
BT 21.10	i60021.10	Menu function key F6	
BT 21.11	i60021.11	Menu function key F5	
BT 21.12	i60021.12	Menu function key F4	
BT 21.13	i60021.13	Menu function key F3	
BT 21.14	i60021.14	Menu function key F2	
BT 21.15	i60021.15	Menu function key F1	
BT 22.0	i60022.0	S16	
BT 22.1	i60022.1	S15	
BT 22.2	i60022.2	S14	
BT 22.3	i60022.3	S13	
BT 22.4	i60022.4	S12	
BT 22.5	i60022.5	S11	
BT 22.6	i60022.6	S10	
BT 22.7	i60022.7	S9	
BT 22.8	i60022.8	S8	
BT 22.9	i60022.9	S7	
BT 22.10	i60022.10	S6	
BT 22.11	i60022.11	S5	
BT 22.12	i60022.12	S4	
BT 22.13	i60022.13	S3	
BT 22.14	i60022.14	S2	

BT 22.15	i60022.15	S1	
BT 23.0	i60023.0	S24	
BT 23.1	i60023.1	S23	
BT 23.2	i60023.2	S22	
BT 23.3	i60023.3	S21	
BT 23.4	i60023.4	S20	
BT 23.5	i60023.5	S19	
BT 23.6	i60023.6	S18	
BT 23.7	i60023.7	S17	
BT 23.13	i60023.13	S26	
BT 23.14	i60023.14	S25	
BT 24.0	i60024.0	Z1	
BT 24.1	i60024.1	Z2	
BT 24.2	i60024.2	Z3	
BT 24.3	i60024.3	Z4	
BT 24.4	i60024.4	Z5	
BT 24.5	i60024.5	Z6	
BT 24.6	i60024.6	Z7	
BT 24.7	i60024.7	Z8	
BT 25		Reserve	
BT 26.0	i60026.0	Is set if the write block has been modified by the BT part. The bit can be reset by the PAI.	
BT 27..29		Reserve	
BT 30	i60030	Length of the write block in the PLC (WR_PLC) in words	
BT 31	i60031	Length of the read block in the PLC (RD_PLC) in words	
BT 32	i60032	Reserve	
BT 33	i60033	Background graphic preselected by the PAI	
BT 34	i60034	Menu element preselected by the PAI	
BT 35	i60035	Access level preselected by the PAI	
BT 36.15	i60036.15	Blinking position	LED in S1
BT 36.14	i60036.14	Blinking position	LED in S2
BT 36.13	i60036.13	Blinking position	LED in S3
BT 36.12	i60036.12	Blinking position	LED in S4
BT 36.11	i60036.11	Blinking position	LED in S5
BT 36.10	i60036.10	Blinking position	LED in S6
BT 36.9	i60036.9	Blinking position	LED in S7
BT 36.8	i60036.8	Blinking position	LED in S8
BT 36.7	i60036.7	Blinking position	LED in S9
BT 36.6	i60036.6	Blinking position	LED in S10
BT 36.5	i60036.5	Blinking position	LED in S11
BT 36.4	i60036.4	Blinking position	LED in S12
BT 36.3	i60036.3	Blinking position	LED in S13
BT 36.2	i60036.2	Blinking position	LED in S14
BT 36.1	i60036.1	Blinking position	LED in S15
BT 36.0	i60036.0	Blinking position	LED in S16

BT 37.15	i60037.15	Yellow LED in S1	
BT 37.14	i60037.14	Yellow LED in S2	
BT 37.13	i60037.13	Yellow LED in S3	
BT 37.12	i60037.12	Yellow LED in S4	
BT 37.11	i60037.11	Yellow LED in S5	
BT 37.10	i60037.10	Yellow LED in S6	
BT 37.9	i60037.9	Yellow LED in S7	
BT 37.8	i60037.8	Yellow LED in S8	
BT 37.7	i60037.7	Yellow LED in S9	
BT 37.6	i60037.6	Yellow LED in S10	
BT 37.5	i60037.5	Yellow LED in S11	
BT 37.4	i60037.4	Yellow LED in S12	
BT 37.3	i60037.3	Yellow LED in S13	
BT 37.2	i60037.2	Yellow LED in S14	
BT 37.1	i60037.1	Yellow LED in S15	
BT 37.0	i60037.0	Yellow LED in S16	
BT 38.15	i60038.15	Reserve	
BT 38.14	i60038.14	Reserve	
BT 38.13	i60038.13	Reserve	
BT 38.12	i60038.12	Reserve	
BT 38.11	i60038.11	Reserve	
BT 38.10	i60038.10	Reserve	
BT 38.9	i60038.9	Reserve	
BT 38.8	i60038.8	Reserve	
BT 38.7	i60038.7	Reserve	
BT 38.6	i60038.6	Reserve	
BT 38.5	i60038.5	Reserve	
BT 38.4	i60038.4	Reserve	
BT 38.3	i60038.3	Reserve	
BT 38.2	i60038.2	Reserve	
BT 38.1	i60038.1	Reserve	
BT 38.0	i60038.0	Reserve	
BT 39.15	i60039.15	Blinking position	LED in S17
BT 39.14	i60039.14	Blinking position	LED in S18
BT 39.13	i60039.13	Blinking position	LED in S19
BT 39.12	i60039.12	Blinking position	LED in S20
BT 39.11	i60039.11	Blinking position	LED in S21
BT 39.10	i60039.10	Blinking position	LED in S22
BT 39.9	i60039.9	Blinking position	LED in S23
BT 39.8	i60039.8	Blinking position	LED in S26
BT 39.7	i60039.7	Blinking position	LED in S25
BT 39.6	i60039.6	Blinking position	LED in S26
BT 39.5	i60039.5	Blinking position	Reserve
BT 39.4	i60039.4	Blinking position	Reserve
BT 39.3	i60039.3	Blinking position	Reserve
BT 39.2	i60039.2	Blinking position	Reserve
BT 39.1	i60039.1	Blinking position	Reserve
BT 39.0	i60039.0	Blinking position	Reserve

BT 40.15	i60040.15	Yellow LED in S17
BT 40.14	i60040.14	Yellow LED in S18
BT 40.13	i60040.13	Yellow LED in S19
BT 40.12	i60040.12	Yellow LED in S20
BT 40.11	i60040.11	Yellow LED in S21
BT 40.10	i60040.10	Yellow LED in S22
BT 40.9	i60040.9	Yellow LED in S23
BT 40.8	i60040.8	Yellow LED in S24
BT 40.7	i60040.7	Yellow LED in S25
BT 40.6	i60040.6	Yellow LED in S26
BT 41.15	i60041.15	Reserve
BT 41.14	i60041.14	Reserve
BT 41.13	i60041.13	Reserve
BT 41.12	i60041.12	Reserve
BT 41.11	i60041.11	Reserve
BT 41.10	i60041.10	Reserve
BT 41.9	i60041.9	Reserve
BT 41.8	i60041.8	Reserve
BT 41.7	i60041.7	Reserve
BT 41.6	i60041.6	Reserve
BT 41.5	i60041.5	Reserve
BT 41.4	i60041.4	Reserve
BT 41.3	i60041.3	Reserve
BT 41.2	i60041.2	Reserve
BT 41.1	i60041.1	Reserve
BT 41.0	i60041.0	Reserve
BT 42.	i60042.	Reserve
BT 43.	i60043.	Reserve
BT 44.	i60044.	Reserve
BT 45.	i60045.	Reserve
BT 46.	i60046.	Reserve
BT 47.	i60047.	Reserve
BT 48..49	i60047.	Reserve
BT 50	i60050	Time HRS : MIN packed BCD (setting only)
BT 51	i60051	Time Month : DAY packed BCD (setting only)
BT 52	i60052	Time Year : Weekday packed BCD (setting only)
BT 53..58		Reserve
BT 59		Reserve
BT 60	i60060	Request flags (are reset by BT, once request has been executed. Set clock
BT 60.9		If reset, all F-keys of BT are blocked
BT 60.15		Status flags
BT 61	i60061	
BT 61.0	i60061.0	Is set if a new read block has been read from the PLC, should be reset by PAI.
BT 62 ..69	i60062	Reserve
BT 70..89	i60070	Beginning of the block of data read from the PLC cyclically The length of the data block is set in BT31.
BT 90..99	i60090	Beginning of the data block to be written to the PLC. The data are transferred to the PLC, provided they have been modified. The max. number of words to be transferred is set in BT30.