SIEMENS

SINUMERIK 880
VT340 Terminal-Emulation

Function Manual 01.93 Edition

Manufacturer Documentation

SINUMERIK 880
VT340 Terminal Emulation

Function Manual

Manufacturer Documentation

Valid for:

Control	*Software Version*
SINUMERIK 880G	1
SINUMERIK 880 GA2	1

January 1993 Edition

SINUMERIK® documentation

Printing history

Brief details of this edition and previous editions are listed below.

The status of each edition is shown by the code in the "Remarks" column.

Status code in "Remarks" column:

A ... New documentation
B ... Unrevised reprint with new Order No.
C ... Revised edition with new status
If factual changes have been made on the page since the last edition, this is indicated by a new edition coding in the header on that page.

Edition	Order No.	Remarks
05.91	6ZB5 410-0HA02-0AA0	**A**
01.93	6ZB5 410-0HA02-0AA1	**C** The Planning Guide, Order No. 6ZB5 410-0HB02-0AA0, Edition 04.91, and the Function Manual, Order No. 6ZB5 410-0HA02-0AA0, Edition 05.91, are combined in this Function Manual, 6ZB5 410-0HA02-0AA1 as from Edition 01.93.

Preliminary Remarks

Notes for the reader

This documentation is intended for users of the SINUMERIK 880 terminal emulator operator panel.

It explains the general purpose of the terminal emulator and describes the start-up of the operator panel.

This documentation contains the functional description of the terminal emulator with the DEC VT340 Terminal functionality (called ”original device” in the following text). In addition to an overview of the functions, a description is given of the actually implemented functions in order to enable the customer to use the offered features with ease. It should be noted in this context that the functional description particularly deals with the differences as compared with the original VT340 device. A more detailed description of the various functions is given in the documentation on the original device.

Section 9 gives a summary of the VT340 functions implemented on the target system in the form of an overview. In addition, project-specific options are also dealt with. These options may be defined as functions not contained in the original device which, however, have proved useful and necessary in the application environment of the VT340 emulator.

A more detailed description of the VT340 terminal functions is given in **Section 10**. This Section gives an overview of the various characteristics of the terminal and is based essentially on the function arrangement in Section 1. The control sequences and their effects are described.

The following trademarks are used in this manual:

- VT340® is a registered trademark of Digital Equipment Corporation
- VT100® is a registered trademark of Digital Equipment Corporation
- DEC® is a registered trademark of Digital Equipment Corporation

Technical comments

This documentation applies to SINUMERIK 880G software version 1.2 and higher and to SINUMERIK 880 GA2 software version 1 and higher.

Contents

1 Brief Description of the VT340 Terminal Emulator

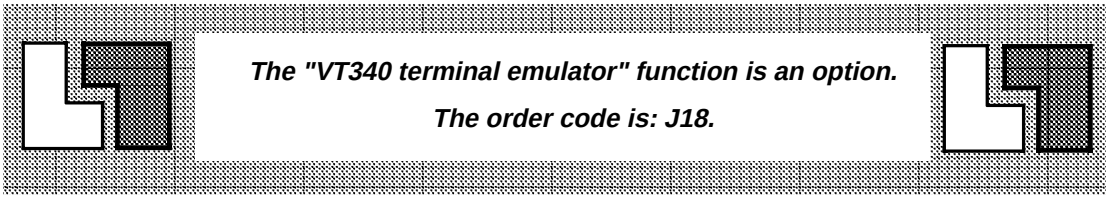
The "VT340 terminal emulator" function enables you to operate a computer using the SINUMERIK 880 operator panel as an input/output unit.

The range of applications for the VT340 terminal emulator includes:

- Linkage of the SINUMERIK 880 to almost any computer system.
- Use of one computer by several SINUMERIK controls.
- Integration in a programming system at work scheduling or supervision level.

2 Detailed Description of the VT340 Terminal Emulator

With the VT340 terminal emulator available as an option for the SINUMERIK 880, you can use the operator panel as a data input/output unit in conjunction with a computer.



2.1 General

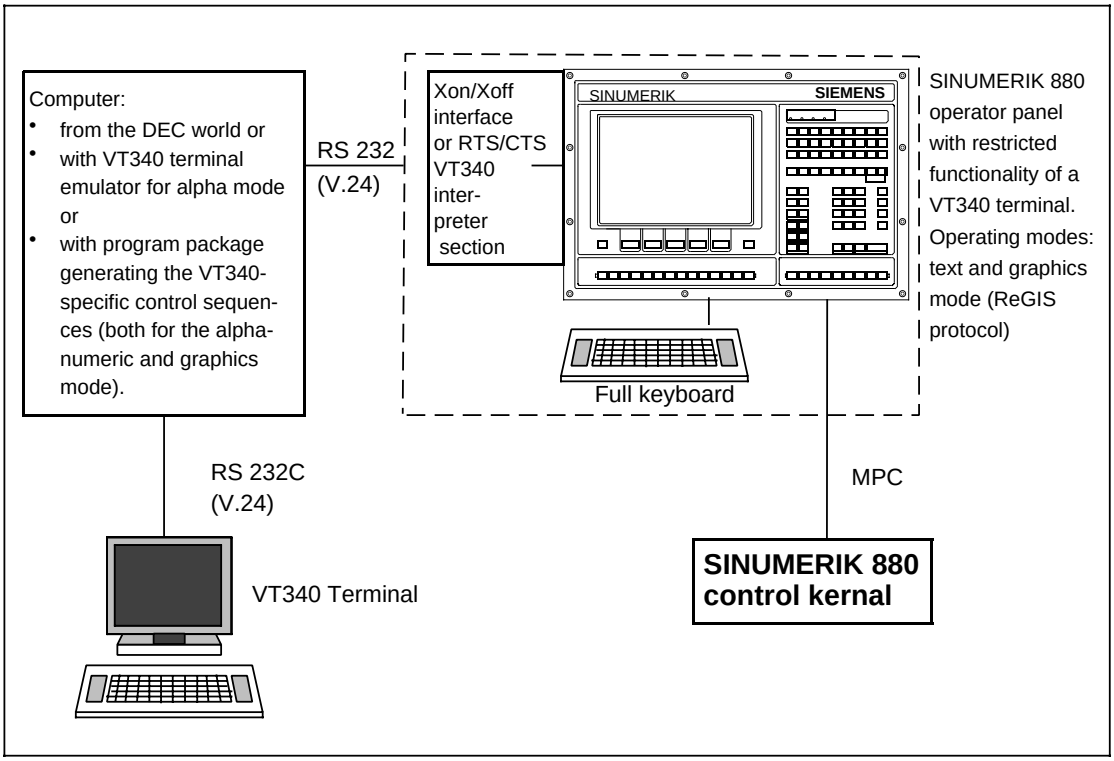
2.1.1 Definition of "Terminal"

A terminal is an "intelligent" input/output unit for use in conjunction with a computer. It enables the full hardware and software capabilities of the computer to be exploited.

2.1.2 VT340 terminal emulator

The VT340 terminal emulator is a software simulation of the DEC (Digital Equipment Corporation) VT340 terminal functions.This terminal with colour capability can be operated in text or graphics mode. In graphics mode, the terminal emulator uses a special DEC graphics protocol called ReGIS graphics (Graphics Instruction Set).

2.1.3 SINUMERIK 880 with terminal emulator



SINUMERIK 880 with terminal emulator

In emulation mode, the SINUMERIK 880 operator panel works like a VT340 terminal except for some restrictions in functionality (the function set available is described in Sections 9 and 10).

Linkage of the SINUMERIK 880 operator panel as a VT340 terminal to a computer is by means of an RS 232C (V.24) interface (S1 or S2). The interface is assigned in the setting data in accordance with the device type. Transmission is performed character-controlled (Xon/Xoff) or with hardware handshake.

NC-specific standard data (e.g. NC part programs, tool offsets, R parameters etc.) cannot be transmitted via the terminal interface. If such data are to be transmitted between the NC and the computer, an interface module for computer linkage (CP 231 with bus interface or CP 315 with serial interface) is required.

You can print out a hardcopy of the screen information in terminal emulation text mode. Printer and SINUMERIK 880 operator panel are linked via an RS 232C (V.24) interface (S1 or S2)). The interface is assigned in the setting data in accordance with the device type.

2.2 Computer configuration

The choice of operating system is largely open. It must incorporate an emulation package for a VT terminal (e.g. VT220). The computer will then behave towards the SINUMERIK 880 in the same way as a VT terminal, at least in text mode.

If the user wants to make full use of the capabilities of the terminal emulator, he must prepare a program package for the computer which generates the DEC-specific control sequences and performs data exchange with the terminal emulator.

2.2.1 Use as DOS terminal

If the VT340 terminal emulator is used, the following must be observed:

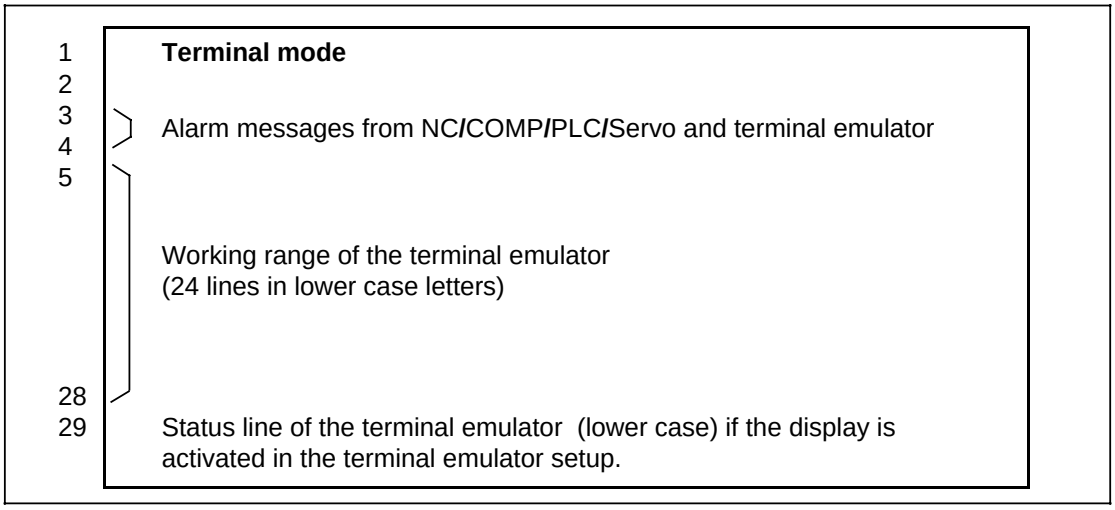
- the characters generated by pressing keys are transferred as ASCII characters to the PC
- these characters are processed within the PC-BIOS
- processing of alphanumeric characters presents no problems
- processing of the special keys, such as the cursor keys, can cause jamming at DOS level e.g. endless sequence of $^{C}_{R}{}^{L}_{F}$).

  Example: Cursor key right generates the following sequence ESC [C
  The DOS versions 3.2 and 3.3 respond to this with an endless sequence of $^{C}_{R}{}^{L}_{F}$.

  Owing to the use of interface software, the sequences must be decoded accordingly and the resulting responses must be initiated.

2.3 Selection and deselection of terminal emulation

Changeover from NC operation to terminal emulation and vice versa is made by a new key arranged to the right of the channel changeover key. Selection can be made at any point in the menu tree and in any operating mode. On selection of terminal emulation, the following screen form will appear:



Layout of the terminal emulator display

The NC display selected prior to activation of the emulation mode is completely regenerated after deselection of emulation mode.

Line break
If a RS 232C (V.24) line break occurs while the terminal emulator is in graphics mode, it is not possible to switch back to the NC mode until the break has been repaired and the graphics mode has been terminated by the computer.

2.4 Connection of a full keyboard

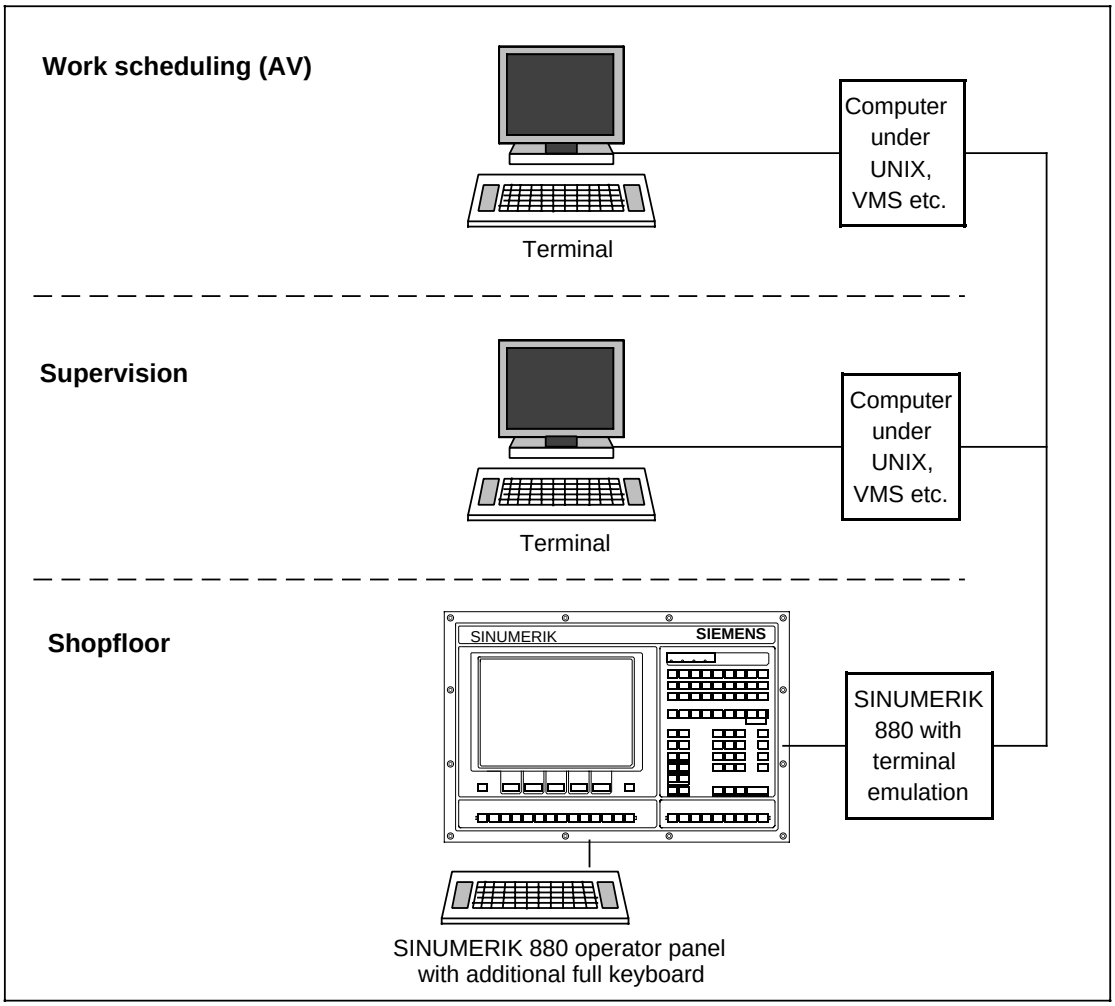
This operator panel allows connection of a full keyboard. The full keyboard is connected directly to the interface keyboard module of the operator panel.

You can perform input via the full keyboard both in emulation and NC mode. This greatly improves ease of operation.

The full keyboard can be connected and disconnected during operation.

2.5 Applications of the SINUMERIK 880 with terminal emulator

2.5.1 Integration in a programming system at work scheduling or supervision level

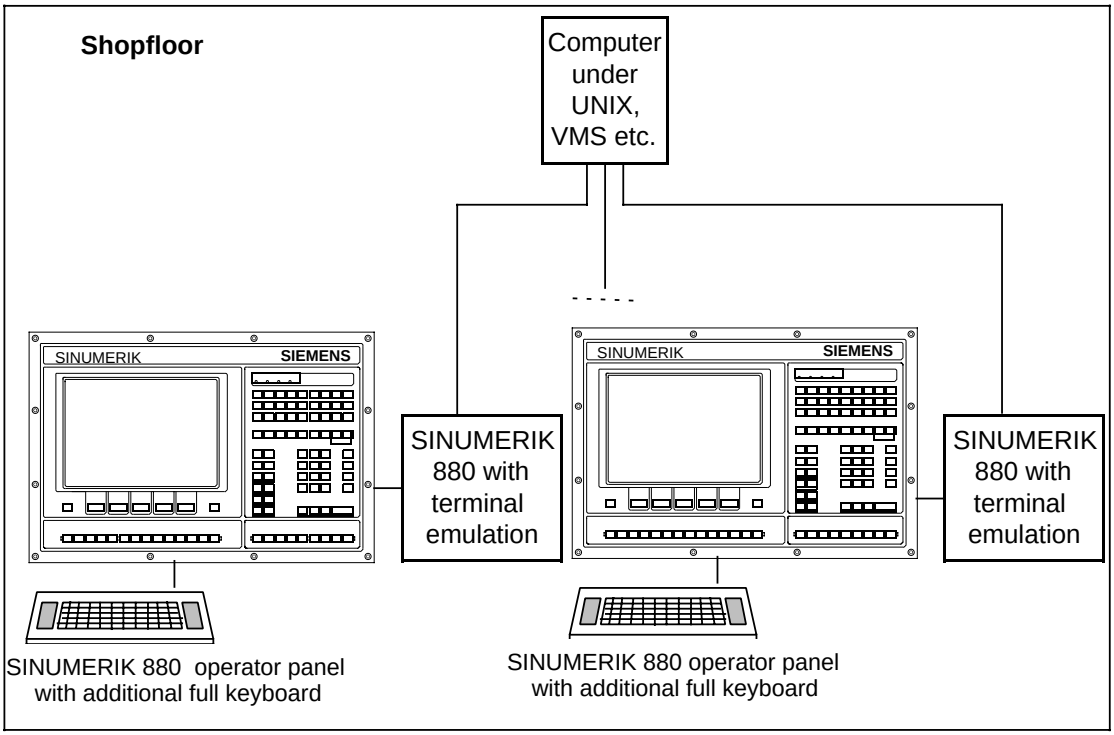


Integration in a programming system

Advantages:

- Uniform, integrated user- and application-specific system at all levels
- Minimum hardware required on the shopfloor, irrespective of the degree of complexity of the programming system
- Optimization of the machining program in source code directly at the machine
- Implicit availability of the optimized source code at work scheduling or supervision level
- Use of further functions such as:
  - production data acquisition
  - order administration
  - tool management etc.

2.5.2 Use of one computer by several controls

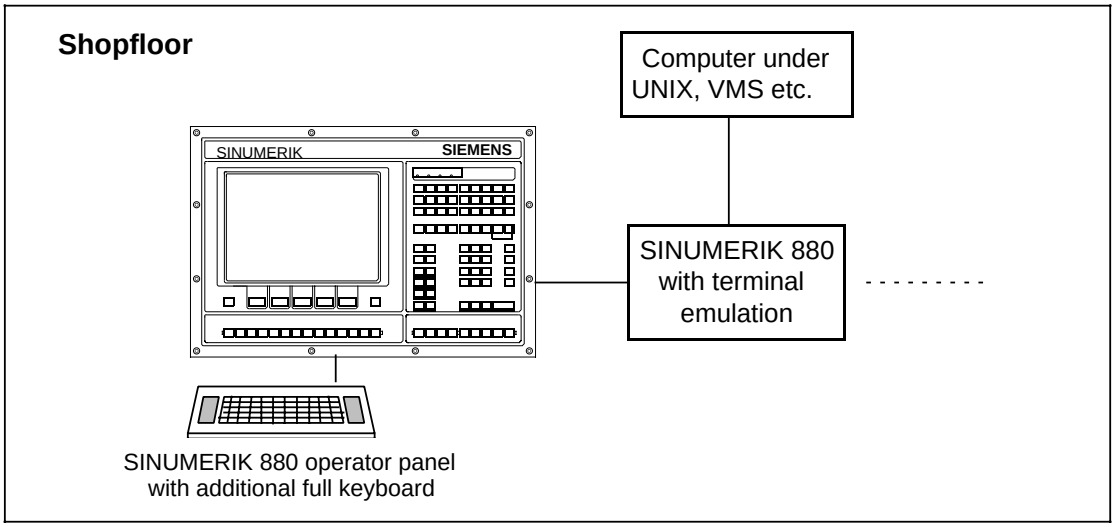


Use of one computer by several controls

Advantages:

- Use of one computer for several machines as a cost-saving factor
- Use of a powerful computer
- Possibility of using the computer for different tasks such as:
  – programming
  – production data acquisition
  – order administration etc.

2.5.3 Linking the NC to almost any computer system



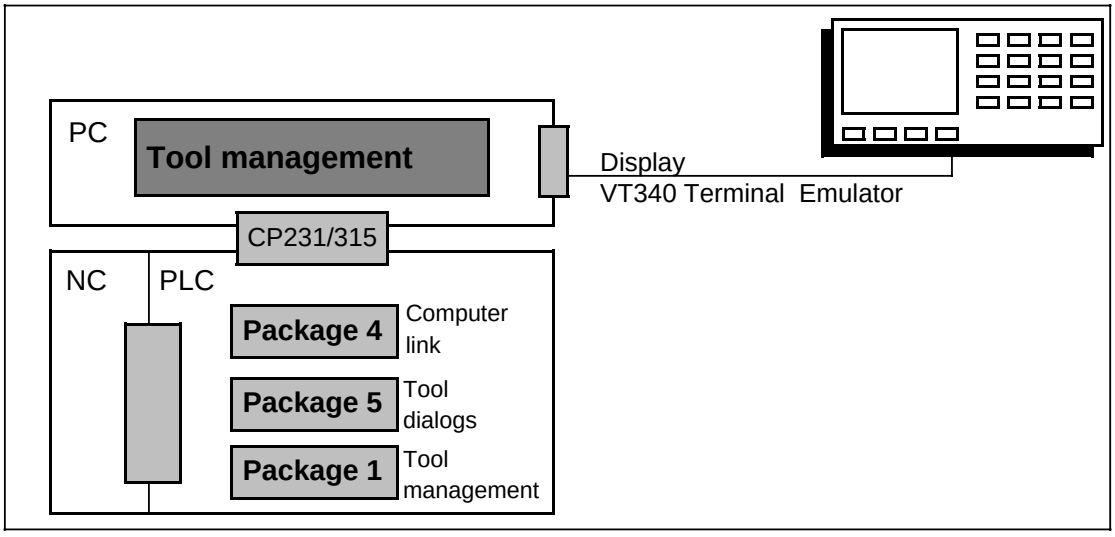
NC linkage

Advantages:

- Possibility of linking the SINUMERIK 880 to a computer to almost any hardware and/or
- almost any operating system.
- Only one screen for operating the computer and the control

Application example: Tool management in the PC

The tool data are transferred between the PC and the SINUMERIK 880 using the computer link (CP 231, CP 315). The PC is linked to the terminal emulation operator panel for display and operation of tool management.



Tool management in the PC

3 General Operating Conditions

3.1 Prerequisites

Hardware

Application of the "VT340 Terminal Emulator" function with the SINUMERIK 880 requires the use of a new operator panel hardware. This hardware is supplied when the "Terminal emulator" Option is ordered.

Software

For use with the SINUMERIK 880 GA2 the "Terminal emulator" Option requires software version 1.

For use with the SINUMERIK 880 G the "Terminal emulator" Option requires software version 1.2.

3.2 Demands on external devices

The VT340 terminal emulator results in considerable adaptation to the DEC world. The ReGIS graphics protocol used by the terminal emulator is important only in a DEC environment.

Computers from the DEC world can be linked without problem using the entire emulation spectrum.

If no DEC computer is available for linkage to the terminal emulator, the following points should be observed with regard to the computer operating system:

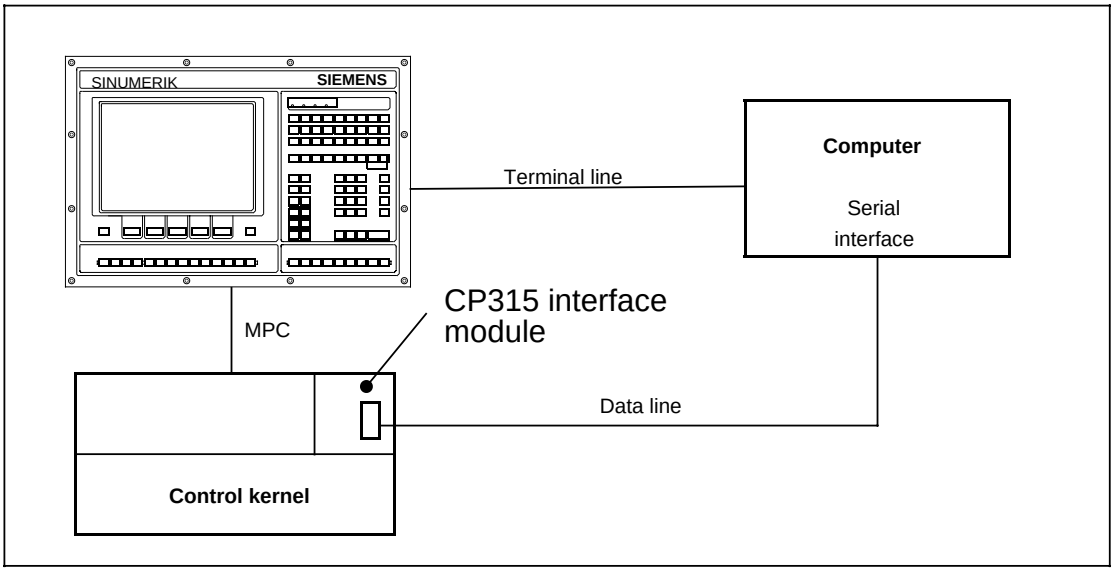
1. Choice of the operating system is largely open. It should incorporate an emulation package for a VT terminal (e.g. VT220). This package provides full compatibility between the terminal emulator and computer, at least in text mode.

   Operating systems such as UNIX and XENIX include an emulation package (ANSI standard) for a VT terminal.

2. If it is intended to use the graphics capability of the terminal emulator, the user must prepare a program package for the computer which generates the DEC-specific graphic sequences and performs data exchange with the terminal emulator.

3.3 Data transfer between NC and computer

The "VT340 terminal emulator" function creates an input/output unit for computer systems. The terminal emulator cannot perform data transfer between computer and NC. It does, however, enable the user to initiate data transfer via existing system components.



Example: Data linkage via the active CP 315 serial interface module

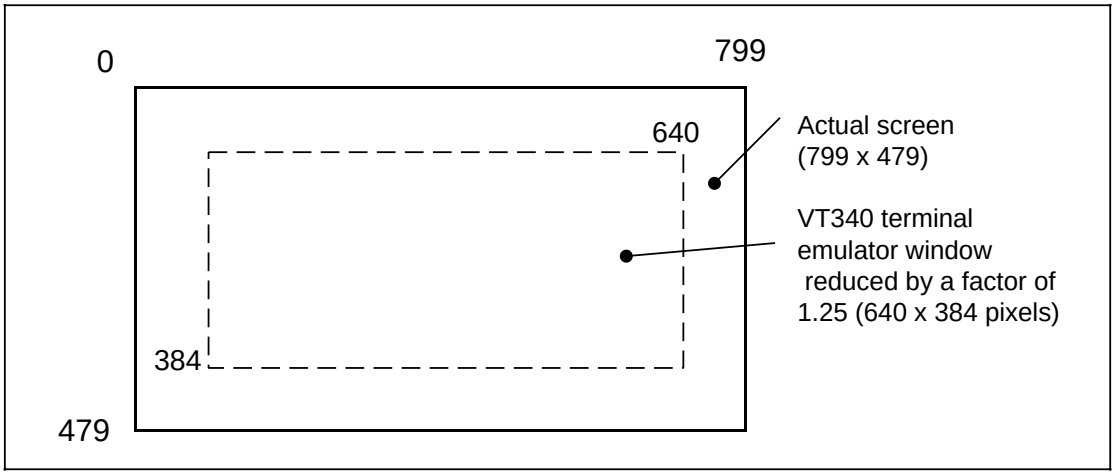
Using the terminal emulator, the user can start a procedure on the computer system that performs data exchange via the computer link module.

3.4 Compatibility

In this Section, incompatibilities between the original VT340 device and the VT340 terminal emulator used with the SINUMERIK 880 are discussed.

Resolution

The original VT340 device has a resolution of 799 x 479 pixels whereas the terminal emulator has a resolution of only 640 x 384 pixels.The terminal emulator must recalculate all position and length values in keeping with its own resolution in order to ensure a true-to-scale display. This can result in image differences between the original device and the terminal emulator.



SINUMERIK window

3.5 Restrictions

Restrictions applying to the SINUMERIK 880G and SINUMERIK 880 GA2 controls:

Keyboard:	The NumLock key is not supported
Cyrillic character set:	The "Cyrillic" language version is not possible.

The following restrictions apply in addition to the SINUMERIK 880 G:

Operator panel:	It is not possible to work without an operator panel nor is it possible to connect a second or third operator panel (without RMOS operator panel).
Customer keys:	If several of the user-assignable keys on the operator panel are pressed at the same time, only the one first recognized is passed on to the PLC (without RMOS operator panel)
Simulation:	Not possible for SINUMERIK 880G

In the SINUMERIK 880 GA2, the following functions are implemented in the RMOS operator panel :

- Operation without operator panel
- Operation with a second and third operator panel
- All customer keys are recognized at the same time
- Simulation

3.6 Internal interface signals

If the ”Terminal mode” function has been activated, the signal VT340 ACTIVE is set to 1 at the internal interface in DB48, DW2, bit 15.

VT340 ACTIVE	**DW 2, bit 15**

1: The control is in the terminal emulator mode. The NC cannot be operated in this mode. Exception: The customer keys are passed on for processing even when the VT340 is active. If the screen saver has been activated (DB48, D0.12) it must be cancelled.

0: The terminal emulator is not active.

4 Operator Panel Start-up

A special point to be observed with this operator panel is that on initial start-up of the control the operator panel must be started up as well.

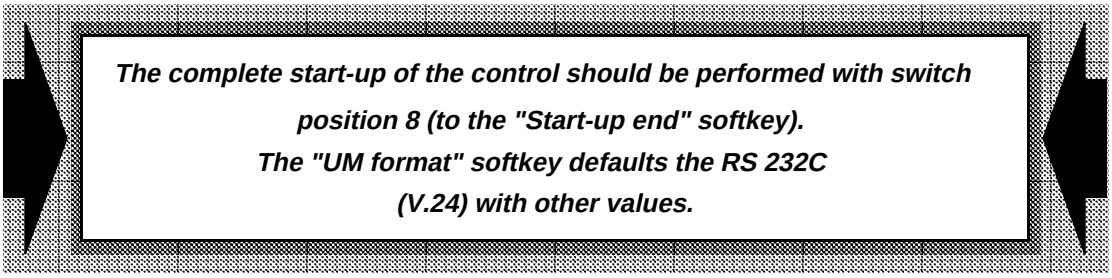
4.1 Initial start-up

Initial start-up of the operator panel is performed automatically when the rotary switch on the operator panel CPU is in position 8.

In this switch position, a cold start of the operator panel system is performed including the following functions:

- Clearing of RAM memory on the operator panel
- Triggering various system initializations
  (e.g. The VT340 Terminal Emulator setup is preset with default values)
- Stack initialization of the operator panel system
- Initialization of serial interfaces S1 and S2 on the operator panel.

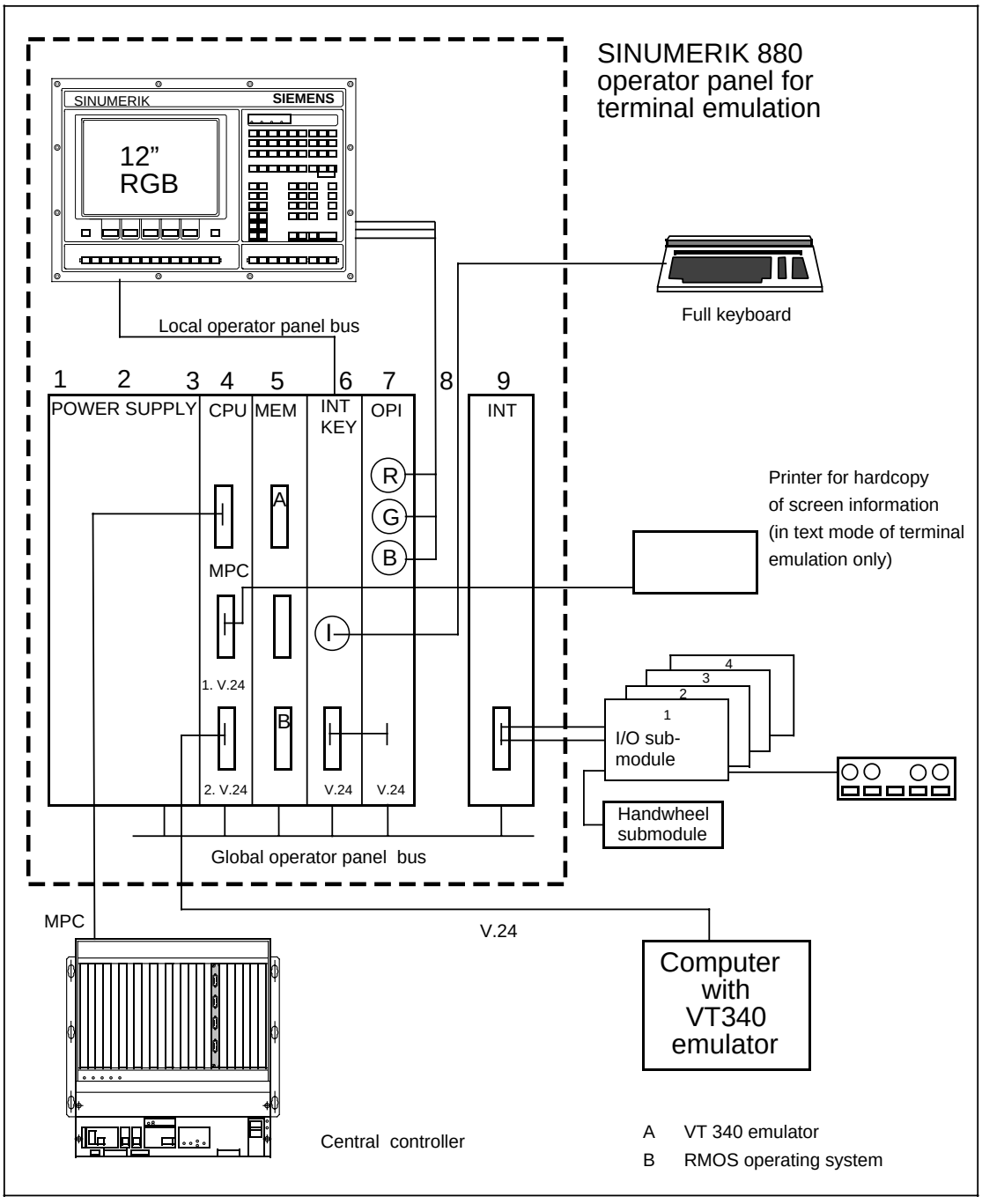
The rotary switch must then be set to normal operation again (position 0).



5 Hardware Description

The technical differences compared with previous SINUMERIK 880 operator panels are given below.

5.1 Hardware configuration of the operator panel



Hardware configuration

5.2 Overview of operator panel modules

Designation	Order No.	Subrack slot 1	2	3	4	5	6	7	8	9	Sub-module slot 1	2	3
BUS/OB							■	■	■				
		■			■	■	■	■	■	■			
Power supply	6EW1861-3AC	◢	◢	◢									
CPU operator panel (128 kB RAM)	6FX1120-4BD				◢								
MEM/EPROM	6FX1128-1BB					◢							
Operator panel software											◢		
Spare submodule													
RMOS operating system													◢
INT KEY	6FX1148-7BA						◢						
INT OPI	6FX1138-8BC							◢					
INTERFACE	6FX1121-2BB									◢			
Front panel									◢				

◢ Basic version

◢ Maximum option possible

◢ Possible alternative configuration option

The back-up battery is located at the rear of the operator panel. It backs up the terminal emulation setup data when the control is switched off.

The specification of the modules incorporated in the operator panel is contained in the following documentation

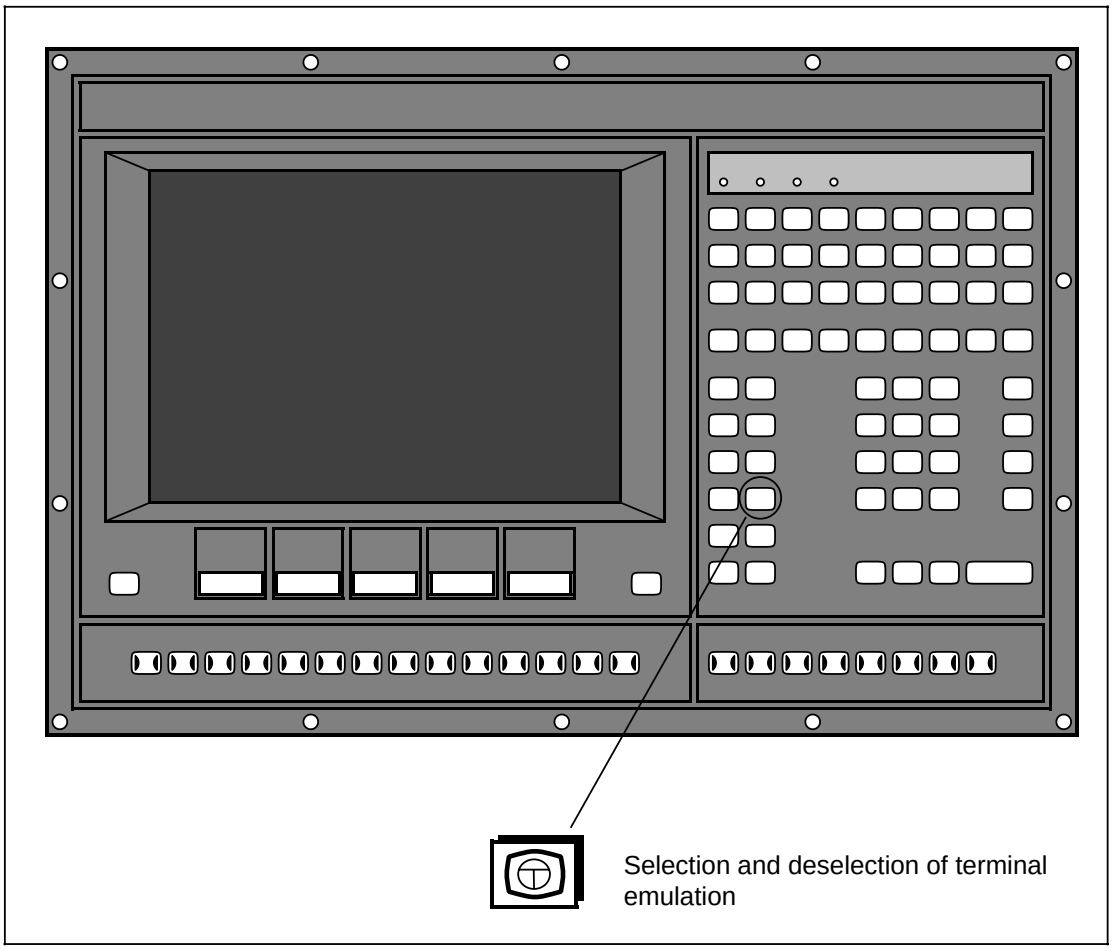
SINUMERIK 880
Interface Description Part 2: Connection Conditions

6 Operation and Display

6.1 Changeover NC/emulation mode

You change over between NC operation and terminal emulation by means of the key on the right of the channel changeover key. Terminal emulation can be selected at any time in the operating mode.

Alarm 3020 "Option not available" is displayed if the "VT340 terminal emulator" Option is not activated.



Selection and deselection of terminal emulation

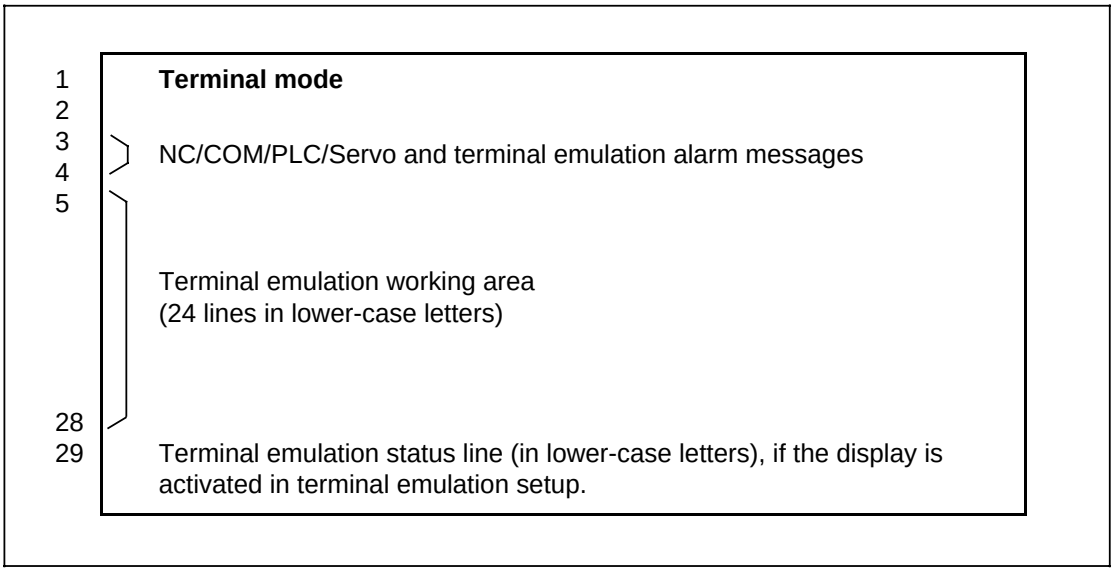
6.1.1 Selection of terminal emulation

Selection of terminal emulation is performed in two steps:

- Output of a special display for terminal operation. The screen is completely cleared and the text "Terminal operation" is displayed in the first line left-justified.
- Start of terminal emulation. The contents of the shadow memory of the terminal emulator is displayed on the screen. When terminal emulation is selected for the first time only the cursor appears. On repeated selection, the last current terminal emulation display is output (only those parts of the display output in text mode)
- When VT340 is selected, a plausibility check of the setting data is performed. If none of the serial interfaces has been assigned to the VT340 device type, alarm 3060 "VTE340 cannot be called" is set.

6.1.2 Display layout during terminal emulation

The working area of the terminal emulator has a fixed size of 1 x 24 characters. This cannot be parameterized, not even in the setup mode.



Display layout during terminal emulation

6.1.3 Deselection of terminal emulation

If terminal emulation is in a state allowing termination, the NC display selected prior to terminal emulation is completely regenerated. Terminal emulation cannot be terminated if it is in one of the following states:

- VT340 setup mode
- VT340 graphics mode (ReGIS protocol)
- VT340 local edit mode

If nevertheless an attempt is made to terminate emulation in these states, alarm 3058 "VT340 cannot be terminated" is displayed.

6.1.4 Terminal emulator shadow memory

If terminal emulation is in text mode, all characters written on the screen are simultaneously written into a second screen memory (so-called shadow memory). This shadow memory serves to restore the previously existing screen information of the terminal emulator text mode after changeover between NC mode and emulation mode.

Previously existing screen portions of terminal emulation can be regenerated in text mode only.

6.1.5 Terminal emulator configuration

Using the terminal emulator, you can configure the behaviour of the terminal by means of terminal setup to suit your individual needs. The possibilities offered by the setup mode are described in Sections 9 and 10.

The current terminal state at a given time is protected in the backed-up operator panel RAM which ensures that the terminal configuration is preserved when the control is switched off.

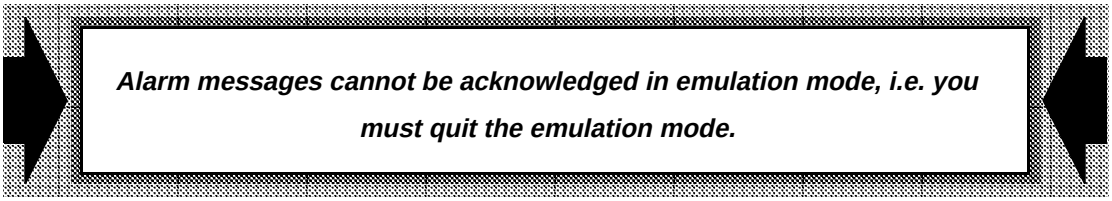
Note:

The terminal setup is preset with default values on initial start-up of the operator panel (rotary switch position 8 on the operator panel CPU).

6.2 Terminal emulator alarm messages

In the following, VT 340 specific alarm messages are described which are displayed when faults or malfunctions occur.

In addition, alarms are also displayed in emulation mode. These alarms are set by the control which continues to operate in the background.



7	**Battery alarm operator panel**	
Scan:	After POWER ON, cyclic	
Effect:	Data are lost when the control is switched off	
Explanation:	The battery voltage has dropped to a level which no longer ensures backup of setup data for terminal emulation.	
Remedy:	Replace battery in operator panel under power and acknowledge alarm with the acknowledge key after setup data have been checked and corrected if necessary. **Note:** The control must not be switched off until the battery has been replaced (otherwise data are lost).	

3058	**VT340 cannot be aborted**	
Scan:	Each time terminal emulation is deselected	
Effect:	Terminal emulation cannot be terminated in this operating mode (return to NC operation not possible).	
Explanation:	Exit from emulation is not allowed when terminal emulation is in setup, graphics or local edit mode.	
Remedy:	• Quit terminal emulation setup mode • Quit terminal emulation graphics mode • Quit terminal emulation local edit mode	

3059	**Setup cannot be called**	
Scan:	Each time setup mode is selected	
Effect:	Setup mode cannot be selected during terminal emulation	
Explanation:	Setup must not be selected when terminal emulation is in graphics mode.	
Remedy:	Quit terminal graphics mode	

3060	**VTE 340 cannot be called**	
Scan:	Each time terminal emulation is called	
Effect:	Terminal emulation does not function	
Explanation:	None of the serial interfaces of the operator panel has been assigned to terminal emulation.	
Remedy:	The serial interface of the operator panel (to be used by the VTE340) must be assigned the device VTE340. The assignment is effected by modifying the setting data for the corresponding interface.	

3098	**VTE communication error**	
Scan:	Cyclic each time data is transmitted from the VTE to the computer	
Effect:	The RS232C (V.24) link between the VTE340 and the computer is faulty	
Explanation:	While transmitting data (VTE340 to computer) an error has occurred which prevents transmission (e.g. cable not plugged in). All further transmission to the computer is suppressed until the problem has been eliminated.	
Remedy:	Check the RS232C (V.24) communication problem on the computer side and the RS232C (V.24) link between the VTE340 and the computer.	

6.3 Use of keyboards

This operator panel allows a full keyboard (IBM-compatible multifunction keyboard) to be connected. The full keyboard can be used in emulation and NC mode and improves ease of operation considerably compared with the operator panel keyboard. In addition, you can use the operator panel keyboard both for NC standard operation and terminal operation.

However, for operation in emulation mode, dual assignment of the operator keyboard is required.

6.3.1 Assignment of operator panel keyboard in NC mode

Assignment of the operator panel keyboard in NC mode has not been changed except for the additional key for selecting and deselecting terminal emulation.

Selection and deselection of terminal emulation

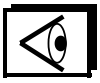
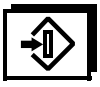
6.3.2 Assignment of operator panel keyboard in terminal mode

You can operate the computer in emulation mode also via the standard operator panel if the full keyboard is not connected. In this case, however, the keys are not labelled.

As the full keyboard incorporates far more keys than the operator panel keyboard, double assignment had to be introduced for the operator keyboard. Assignment of the operator panel keyboard in emulation mode is described below.

Initial assignment of the operator panel keyboard in emulation mode

The initial assignment of the operator panel keyboard is active with default values when terminal emulation is selected. The following keys have different meanings in emulation mode:

Key	
	Changeover to second assignment of the operator panel keyboard (This key is latched during subsequent key operation)
	Find key
	Remove key
	Insert key
	Select key
	Delete key
	Function key F13 (LF)
	CTRL key (This key is latched during subsequent key operation).
	Function key F11 (ESC)
	Function key F14
	Function keys F6 . . . F10

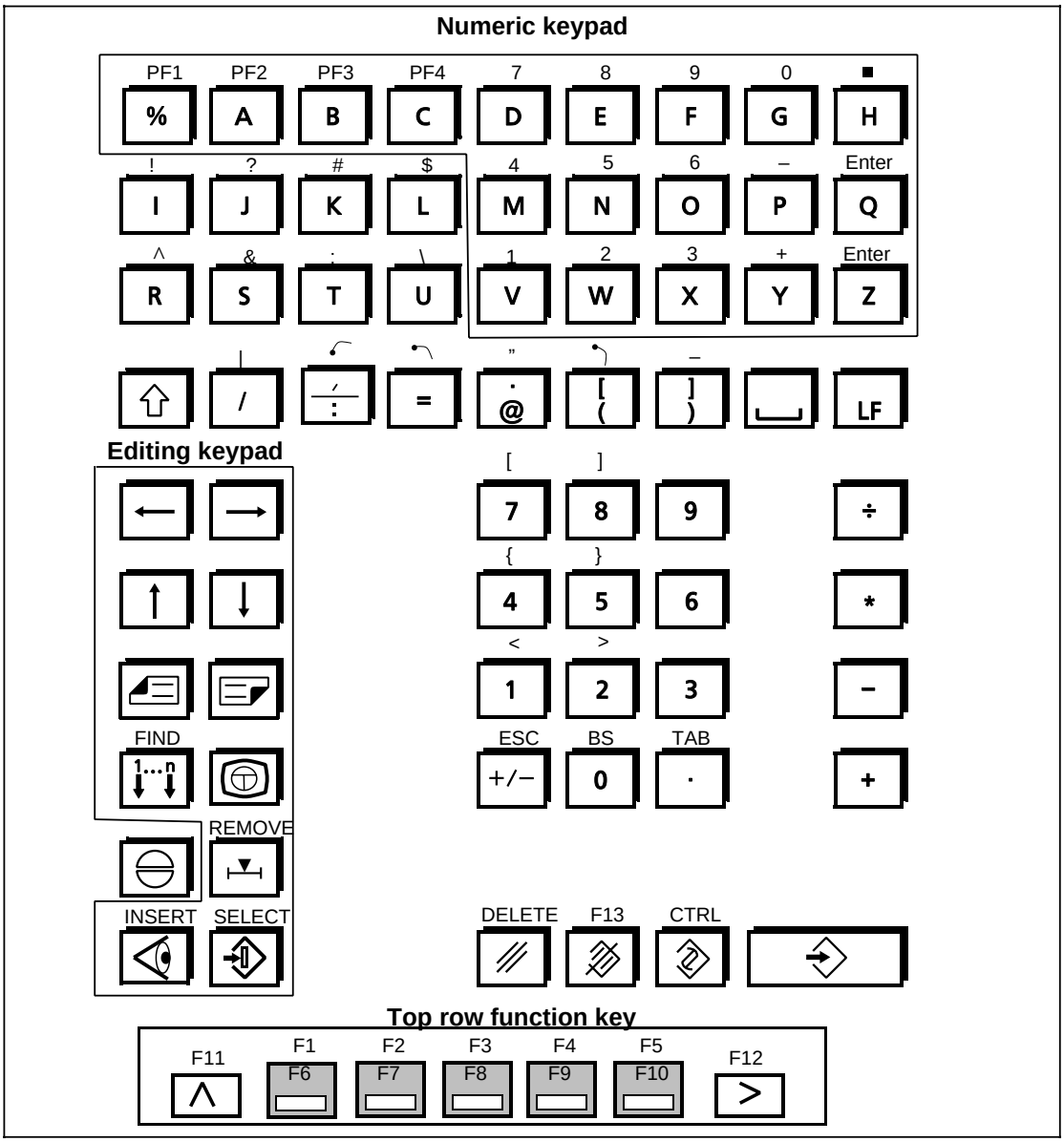
Second assignment of operator panel keyboard in emulation mode

You change over the operator panel keyboard to the second assignment by pressing the  - key

Since the changeover key latches, it must not be pressed simultaneously with another key.

Examples:

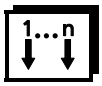
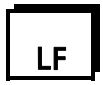
Desired character	1st key operation =changeover to second assignment	2nd key operation
Semicolon (;)		T
PF1		%



Assignment of operator panel keyboard in emulation mode

6.3.3 Full keyboard assignment in NC mode

In NC mode, the full keyboard can be used to operate the NC in the standard way. Some SINUMERIK-specific operating functions have been put on the full keyboard to make this possible.The following key functions are concerned:

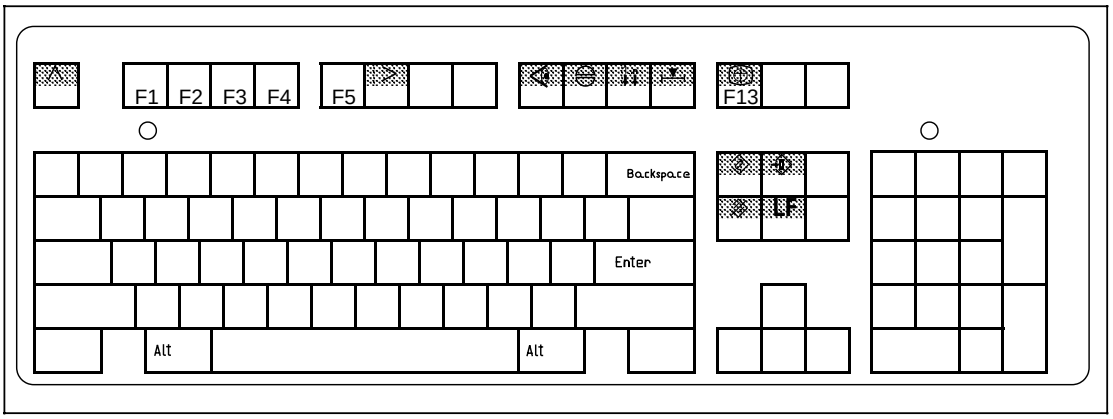
- 5 softkeys including ETC and RECALL key
- Control keys for
  - Diagnostics and start-up 
  - Acknowledge alarm 
  - Change channel 
  - Actual position with double character size 
  - Selection/deselection of terminal emulation 
- Edit and input keys
  - Edit word 
  - Search key 
  - Delete word/block 
  - End of block (LINE FEED) 

The relevant key symbols for these key functions are supplied with the full keyboard. Replace the respective key covers and you obtain the SINUMERIK-specific key assignment.

The other keys on the full keyboard are enabled in NC mode in accordance with the standard operator panel assignment (see Instruction Manual). The input key is equivalent to the Enter key on the full keyboard. Similarly, the Delete or Clear key corresponds to the Backspace key.

Note:

The customer keys and the selection keys for the mode groups are not contained on the full keyboard.



Full keyboard assignment in NC mode

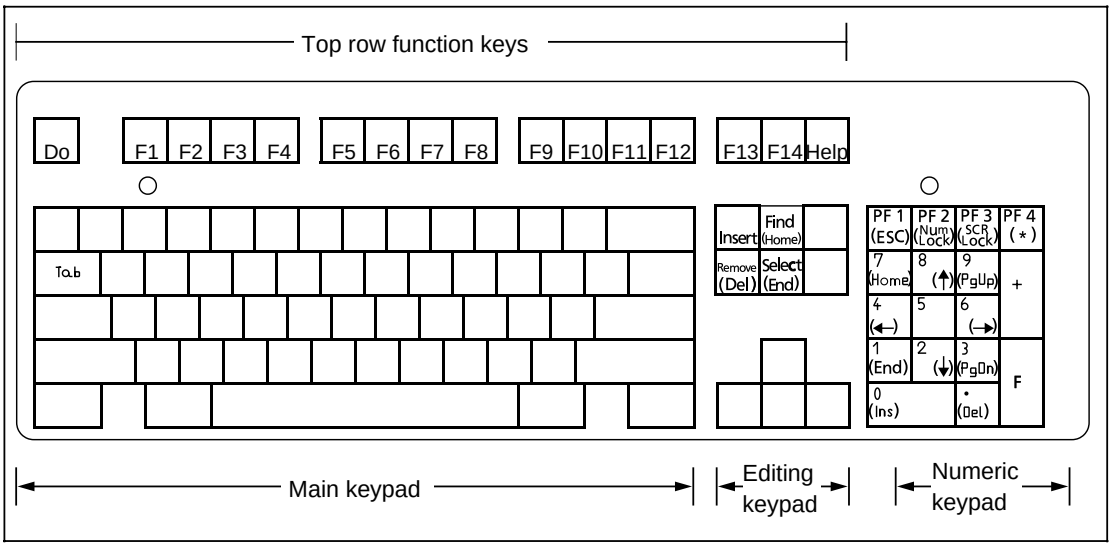
Clear =^ Backspace
Input =^ Enter
Alt+F13 =^ Selection/deselection of terminal emulation

6.3.4 Full keyboard assignment in emulation mode

The original DEC VT340 keyboard is shown on the full keyboard in emulation mode.

Note:

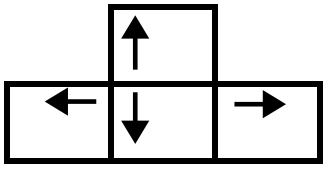
The key assignments in brackets are not used by the terminal emulator (similar to original DEC VT340 keyboard).



Full keyboard assignment in emulation mode

Editing keypad

Insert	Find (Home)	PgUp (PgUp)
Remove (Del)	Select (END)	PgDu (PgDu)



The following key codes are generated:

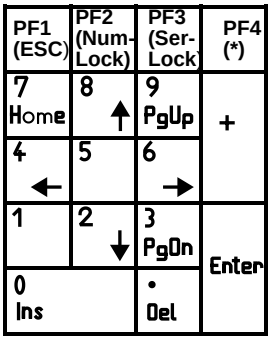
Key	VT300 mode	VT100 mode	Key	Cursor key mode	
				Normal	Application
Find	CSI 1	No code is generated in this mode		CSI A	SS3A
Insert	CSI 2			CSI B	SS3B
Remove	CSI 3			CSI C	SS3C
Select	CSI 4			CSI D	SS3D
PgUp	CSI 5				
PgDn	CSI 6				

Note:

CSI (Control sequence introducer) =^ ESC [
SS3 (Single shift 3) =^ ESC O

Selection of the cursor key mode (normal or application) is made by terminal setup.

Numeric keypad

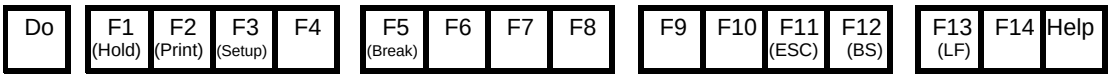


The following key codes are generated:

Key	Keypad mode	
	Numeric	Application
0	0	SS3p
1	1	SS3q
2	2	SS3r
3	3	SS3s
4	4	SS3t
5	5	SS3u
6	6	SS3v
7	7	SS3w
8	8	SS3x
9	9	SS3y
+	+	
.	.	SS3n
Enter	CR or CRLF	SS3M
PF1	SS3P	SS3P
PF2	SS3Q	SS3Q
PF3	SS3R	SS3R
PF4	SS3S	SS3S

Selection of the keypad mode (numeric or application) is made by terminal setup.

Top row function keys



The following key codes are generated:

Key	VT300 mode	VT100 mode
F1 F2 F3 F4 F5	– – – – –	– – – – –
F6 F7 F8 F9 F10	CSI 17 CSI 18 CSI 19 CSI 20 CSI 21	– – – – –
F11 F12 F13 F14 F15 (Help) F16 (Do)	CSI 23 CSI 24 CSI 25 CSI 26 CSI 28 CSI 29	ESC BS LF – – –

The keys F1..F5 are local function keys. These keys do not generate a code.

Meaning of the function keys

F1 (Hold) — Interrupts data transfer to the termina (XOFF is sent to the computer)

F2 (Print) — The terminal emulation display area (text mode) is sent to the printer.

F3 (Setup) — Selection/deselection of terminal setup

F5 (Break) — Influences communication between computer and terminal emulator

F13 (LF) — This key generates the LF character in the VT 100 mode. (= CTRL J)

F6 • • • Do — These keys are available to the application software in VT 300 mode.

7 Interface Adaptation to Peripheral Devices

7.1 General

Peripheral devices are distinguished by the type of data transfer. This operator panel version offers the following possibilities:

- Line-controlled devices:
  Control operation via DSR, DTR, CTS, RTS control lines
- Character-controlled devices:
  Control operation via control characters on the data lines

The peripheral device is activated by setting data according to interface and data direction. The control lines are activated only by the connection. The following device types are available for the serial interfaces S1 and S2.

- Device 0
  Line-controlled devices
- Device 1
  Line-controlled devices
- Device 11 Hex
  Teleservice
- **Device 12 Hex**
  Terminal emulator
- **Device 13 Hex**
  Printer for hardcopy in terminal emulation mode

Note:
If the device type ”Terminal emulator” has been assigned to the serial interfaces of the operator panel (S1/S2), the VT340 operates by default on S1. The link to the host computer must be connected to S1.

RMOS operator panel

On initial start-up, the interface is defaulted with presetting of machine and setting data as follows:

Interface S1:	Printer for hardcopy in terminal emulation (13 hex)
Interface S2:	Terminal emulation (12 hex)

7.2 Setting data

With the RMOS operator panel, the setting data of the 1st and 2nd interface are written with default values on initial start-up:

Interface S1

SD 5010, SD 5012	Device code 13 hex (printer for hardcopy in terminal emulation)
SD 5011, SD 5013	Transmission format 9600 baud, no parity, 2 stop bits
SD 5014	Xon character 11 hex (DC1)
SD 5015	Xoff character 13 hex (DC3)
SD 5016	Special bits Main programs and subroutines according to System 800 format Data output without leader and trailer "DSR" line is not evaluated Read-in stop with M02/M30 Output in ISO code Termination of block on output with CR LF Read-in start with % Output start on request via Xon character
SD 5017	Special bits Time watchdog switched off Reorganization

Interface S2

SD 5018, SD 5020	Device code 12 hex (terminal emulation)
SD 5019, SD 5021	Transmission format 9600 baud, ohne parity, 2 stop bits
SD 5022	Xon character 11 hex (DC1)
SD 5023	Xoff character 13 hex (DC3)
SD 5024	Special bits Main programs and subroutines according to System 800 format Data output without leader and trailer "DSR" line is not evaluated Read-in stop with M02/M30 Output in ISO code Termination of block on output with CR LF Read-in start with % Output start on request via Xon character
SD 5025	Special bits Time watchdog switched off Reorganization

Device type code greater than 6 is displayed as type 0 (Xon/Xoff) in the "Data input/output" system display (on SINUMERIK 880G only).

SINUMERIK 880 GA2 :

Terminal emulator device	VTE-340
Printer device	VTE-LPT
Teleservice device	TELE-S.

Data common to interfaces S1 and S2:

SD 5026	EIA code for ”@” 6D hex
SD 5027	EIA code for ”:” 48 hex
SD 5028	Code for end of transmission 03 hex (ETX)

8 Service and Diagnostics

8.1 Power-on diagnostics SINUMERIK 880G

Each time the system is started, start-up diagnostics are output on the SINUMERIK screen for service purposes. The start-up diagnostics consist of different operator panel system messages which mirror the start-up behaviour of the control to the operator.

These system messages are written on screen page 2 and cleared when the SINUMERIK 880 basic display appears.

Standard messages are in "yellow". Special messages, e.g. for initial start-up or stack overflow are in "red".

8.1.1 System messages during initial start-up SINUMERIK 880G, SW1

(Rotary switch position 8 on the operator panel CPU)

Power-On-Diagnostic

SINUMERIK 880/VTE

1 GGS		OK	7 ROT	START OK	8 INI	OK
3 MPC		OK				
4 POT		OK				
5 GMC		OK				
2 VT	INIT	OK				
6 USER	INITSTART					

System messages during initial start-up differ only slightly from those during normal operation (rotary switch position "0" on the operator panel CPU).

System message "6" indicates initial start-up and is output in "red".

8.1.2 System messages during start-up SINUMERIK 880 GA2 and SINUMERIK 880G SW2

Every Power On causes the SINUMERIK 880 GA2 operator panel power up diagnostics to be output to screen. The default switch position on the operator panel CPU must be 0. Switch position 8 is set only during initial installation and start-up or if the operator panel battery has failed. In each case, the same diagnostics display is shown on the screen.

System		Application	
GGS	OK	STACK	OK
VTE	OK	ROT	OK
MPC	OK	BAS	OK
POT	OK		
		DIO	OK
GMC	OK		
		DBT	OK
DEBUG	OK		
Application	OK		
Operator Panel CPU Switch	8		

The diagnostics display is automatically replaced after a certain time by the basic display for the mode which has been set.

The messages for the various items of diagnostics can be of the following kind:

OK (green background):	No error
INIT (yellow background):	Data is momentarily being initialized
ERROR (red background):	Error or no function

Meaning of the diagnostics items:

GGS:	The visualization unit is functioning.
VTE:	Terminal emulation data areas are being initialized even if the option is not available.
MPC:	There is a link between the operator panel and the central controller.
POT:	Keyboard processing and the I/O module handling is OK.
GMC:	The visualization unit is functioning.
DEBUG:	This system message states that the RMOS debugger is operable (this is only of interest to development engineers).
Application:	The RMOS operating system has run up and now starts the application.
Stack:	The application stack is tested at switch position 0 and initialized a switch position 8.
ROT:	The initializing routine of the application is started.

BAS: The operator panel operating sequence control is started

DIO: The RS232C (V.24) interfaces on the operator panel are ready to operated.

DBT: The data link via the general data channel side between the operator panel and the control is functioning.

The ”Operator panel CPU switch” display reflects the position of the CPU rotary switch of the operator panel CPU.

Significance for the user:

For the user, the following system messages are of significance and must be observed appropriately.

STACK ERROR

If this error occurs, the operator panel must be put through the start-up routine (Power On with CPU rotary switch position ”8” on the operator panel).

MPC INIT

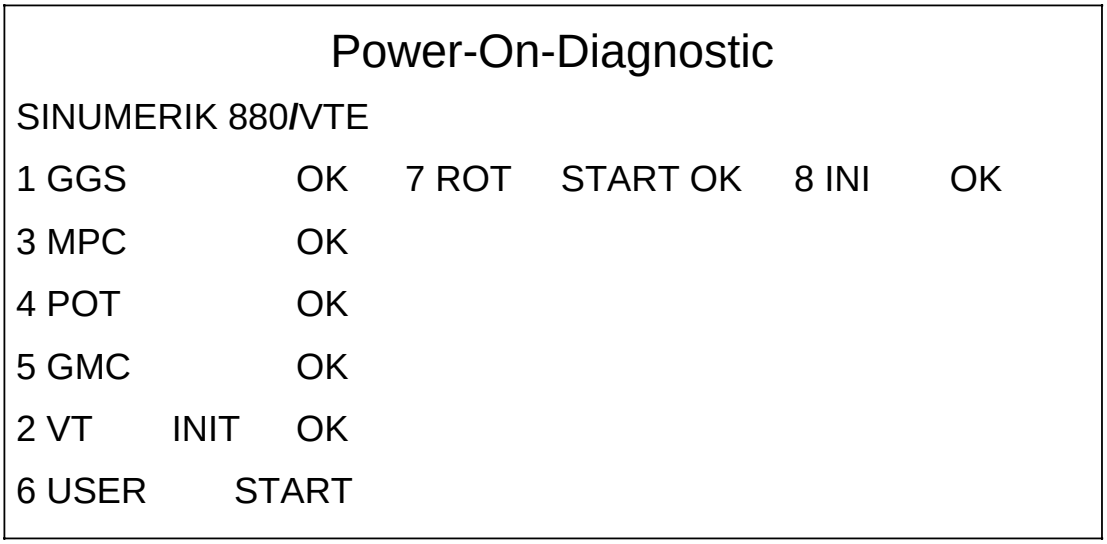
At Power On, the system remains in this constellation. The operator panel cannot be linked to the control via the MPC.
If this error occurs, the control must be powered up in the start-up mode (of the COM CPU).

POT INIT

At Power On, the system remains in this constellation. The link between the OPI card (operator panel interface) and the INTKEY card (interface keyboard) cannot be established. If this error occurs, the reset button on the INTKEY card on the operator panel must be operated and the control must be put through the Power On procedure.

8.1.3 System messages during normal operation SINUMERIK 880

(Position ”0” of the rotary switch on the operator panel CPU)



Meaning of the system messages:

GGS/GMC:	The visualization unit is functioning
MPC:	There is no link between the operator panel and the control kernel
POT:	Keyboard processing and logic module handling are OK
VT INIT:	Terminal emulator data areas are being initialized (even if option not available).
USER INIT:	The operator panel is in initial start-up (rotary switch position ”8” on operator panel CPU)
ROT START:	Operator panel system ready for operation.

8.2 Stack monitoring

A pattern is written into the stack of all application stacks during initial start-up of the operator panel (rotary switch position 8 on the operator panel CPU).

In the normal case (rotary switch position "0" on the operator panel CPU), the stack is monitored once using the pattern written into the stack area on initial start-up.

An error message appears in the diagnostic display when a stack overflow occurs (system message 7, "ROT START OK INI OK" is replaced by the "STACK OVERFLOW" message).

```
                Power-On-Diagnostic
SINUMERIK 880/VTE
1 GGS              OK    7 STACK OVERFLOW
3 MPC              OK
4 POT              OK
5 GMC              OK
2 VT       INIT    OK
6 USER     START
```

Procedure on STACK OVERFLOW

Cause: The battery in the operator panel for backing up the terminal emulator setup data and the stack area is empty.

Remedy: Check battery and replace if necessary. The rotary switch on the operator panel CPU must then be set to position "8" followed by POWER ON. The setup data should then be checked. Report to Service if the fault occurs frequently with the battery intact.

8.3 RAM test

A faultless RAM test is performed on the operator panel after the control has been powered up. The red LED on the operator panel CPU starts flashing when a fault is detected.

Procedure when RAM is faulty

The rotary switch on the operator panel CPU must be set to "8" followed by POWER ON when a RAM fault is detected. After this, the rotary switch can he reset to position "0". Report to Service, if the fault occurs frequently with the battery intact.

9 VT340 Terminal Emulator Functionality

The following Section provides an overview of the VT340 Terminal Emulator functions:

The various functions of the original device are listed and those actually implemented are marked with a plus sign. The minus sign means that the relevant function is not implemented. A detailed description of the various functions and of the control sequences triggering them is given in Section 10.

Basically, the VT340 Terminal functions are divided into two categories:

- Text Programming
- Graphics Programming

The following is based on this classification and the functions are listed in the order in which they appear in the relevant terminal descriptions (see also Section 11).

9.1 Text Programming

Emulation VT Series Terminals

selecting an operating level (DECSCL)	+	
select 7-bit C1 control characters (S7C1T)	+	
select 8-bit C1 control characters (S8C1T)	+	
national replacement character set mode (DECNRCM)	–	1)

Using Character Sets

selecting character sets	+	2)
soft character sets	–	1)

Page Memory

set columns per page (DECSCPP)	–	
column mode (DECCOLM)	–	4)
set lines per page (DECSLPP)	+	
origin mode (DECOM)	+	
set top and bottom margins (DECSTBM)	+	
next page (NP)	–	
preceding page (PP)	–	
page position absolute (PPA)	–	
page position backward (PPB)	–	
page position relative (PPR)	–	

1) Only the ASCII and DEC Special Graphic Character Sets are available

2) Changeover only possible between ASCII and DEC Special Graphic Character Sets

4) A maximum of 84 characters can be written horizontally

Setting Visual Character Attributes

select graphic rendition (SGR)	+ 5)
single-width, single-height line (DECSWL)	– 6)
double-width, single height line (DECDWL)	– 6)
double-width, double-height line (DECDHL)	+

Editing and Character Protection

erasure mode (ERM)	+
insert/replace mode (RIM)	+
delete line (DL)	+
insert line (IL)	+
delete character (DCH)	+
insert character (ICH)	+
erase in display (ED)	+
erase in line (EL)	+
erase character (ECH)	+
selective erase in display (DECSED)	+
selective erase in line (DECSEL)	+
select character protection attribute (DECSCA)	+
start protected area (SPA)	+
end protected area (EPA)	+
protected fields attributes (DECPRO)	–

Local editing

edit mode (DECEDM)	+
edit key execution mode (DECEKEM)	+
line transmit mode (DECLTM)	+
transmit termination mode (TTM)	+
VT131 transmit mode (DEC131TM)	+
guarded area transfer mode (GATM)	+
selected area transfer mode (SATM)	+
multiple area transfer mode (MATM)	+
start selected area (SSA)	+
end selected area (ESA)	+
set transmit termination character (DECTTC)	+
transmit line termination characters (DECTLTC)	+
space compression mode (DECSCFDM)	+
transmit execution mode (DECTEM)	+
set transmit state (STS)	+
transmit (DECXMIT)	+

Cursor Movement and Panning

text cursor enable mode (DECTCEM)	+
cursor position (CUP)	+
horizontal and vertical position (HVP)	+
cursor forward (CUF)	+
cursor backward (CUB)	+
cursor up (CUU)	+
cursor down (CUD)	+
pan down (SU)	–

---

5) Uses ASCII-ATTR (GKM-specific, bold is not possible)

6) Only the height and width of a character can be manipulated together

pan up (SD)	–	
pan right (SL)	–	3)
pan left (SR)	–	3)
horizontal cursor coupling mode (DECHCCM)	–	
vertical cursor coupling mode (DECVCCM)	+	
page cursor coupling mode (DECPCCM)	+	

Keyboard, Printing and Display Commands

keyboard action mode (KAM)	+	
backarrow key mode (DECBKM)	+	
line feed**/**new line mode (LNM)	+	
autorepeat mode (DECARM)	–	7)
autowrap mode (DECAWM)	+	
cursor keys mode (DECCKM)	+	
keypad application and numeric modes (DECKPAM**/**NM)	+	
numeric keypad mode (DECNKM)	+	
keyboard usage mode (DECKBUM)	–	
user-defined keys (DECUDK)	+	
printer port control functions	–	8)
local echo: send**/**receive mode (SRM)	+	
light or dark screen: screen mode (DECSCNM)	–	
scrolling mode (DECSCLM)	–	9)
select active status display (DECSADD)	+	
select status display type (DECSSDT)	+	

VT300 Reports

device attributes (DA)	–	
terminal identification (DECID)	+	
device status report (DSR)	–	
VT300 operating status	–	
cursor position report (CPR)	+	
printer port	–	
user-defined keys	+	
keyboard dialect	–	
locator device port	–	
request terminal state report (DECRQTSR)	–	
terminal state report (DECTSR)	–	
color table report (DECCTR)	–	
restore terminal state (DECRSTS)	–	
request presentation state report (DECRQPSR)	–	
cursor information report (DECCIR)	+	
tab stop report (DECTABSR)	–	
restore presentation state (DECRSPS)	–	
request mode (DECRQM)	–	
report mode (DECRPM)	–	
set mode (SM)	–	
reset mode (RM)	–	

3) Maximum 80 columns per line

7) Autorepeat always active

8) Printer port not available (hardcopy only possible via the second serial interface)

9) Jump-scroll only

request selection or setting (DECRQSS)	–
report selection or setting (DECRPSS)	–
save cursor (DECSC)	+
restore cursor (DECRC)	+
request display extent (DECRQDE)	+
report display extent (DECRPDE)	+
user-prefered supplemental set (DECRQUPSS)	–

Resetting Terminal

soft terminal reset (DECSTR)	+
hard terminal reset (RIS)	–
tab clear (TBC)	+

9.2 Graphics Programming

Entering and Exiting ReGis

ReGis is activated and deactivated by device control strings.

enter ReGis mode (DCS p**/**ESC Pp)	+
exit ReGis mode (ST**/**ESC****)	+

Screen Control Command (S)

display addressing (A[X1, Y1] [X2, Y2])	– 10)
scroll argument ([X, Y] **/**<PV number>)	– 10)
hard copy control (H)	–
output mapping control (M)	+ 11)
background intensity control (I)	–
time delay (T)	– 12)
screen erase (E)	+
plane select control (F)	+
temporary write control (W)	–
graphics cursor control (c)	+ 13)
display graphics page (P)	– 10)

Write Control Command (W)

pv multiplication (M)	+
pattern control (P)	+ 14)
foreground intensity (I)	+ 11)
writing styles (V, R, C or E)	+
negative pattern control (N)	–
select horizontal shading (S[,Y])	–
select vertical shading (S[X])	–
select shading character (S'<cvharacter>')	–

10) Omitted because only one screen page can be addressed

11) Implementation according to GKM possibilities

12) No time call available at the GKM interface

13) GKM graphics cursor fix implemented as crosshair

*14) 2**8 possible bit patterns are displayed on 32*

Position Command (P)

absolute position ([X, Y])	+
relative position ([+/–X, +/–Y])	+
absolute/relative position ([X, +/–Y], [+/–X, Y])	+
pixel vector offset position (<PV value>)	+
bounded position stack ((B) <embedded options> (E))	+
unbounded position stack ((S) <embedded options> (E))	+
select gaphics page (<0 or 1>)	– 10)

Vector Commmand (V)

draw dot ([ ])	+
draw line ([X, Y], <PV>)	+
bounded position stack ((B) <embedded options> (E))	+
unbounded position stack ((S) <embedded options> (E))	+
temporary write control (W)	–

Curve Command (C)

circle with center at current position ([X, Y])	+
circle with center at specified position ((C) [X, Y])	+
arc with center at current position ((A<deg>) [X, Y])	+
arc with center at specified position ((A<deg>C) [X, Y])	+
closed curve sequence (spline)	+ 15)
open curve sequence (spline)	+
temporary write control (W)	–

Text Commmand (T)

character set option (A)	– 1)
character spacing (T <position>)	+ 16)
size multiplier (M)	– 17)
size options (S)	+ 18)
string and character tilt options (D) (n*45 Grad)	– 19)
italics option (I)	–
temporary text control (T(B)<arguments>T(E))	– 20)
temporary write control (W)	–

Load Command (L) – 1)

Macrographs (@)

define macrograph (@: <call letter> <definition> @;)	+
invoke macrograph(@ <call letter>)	+
clear macrograph (@: <call letter> @;)	+

---

1) Only ASCII and DEC Special Graphic Character Set available

15) Splines are implemented as straight lines at the present time

16) Implementation according to GKM possibilities, fixed character cells

17) Omitted, because direct access to character cells is not possible

18) Implementation according to GKM possibilities (zoom factor); width and height cannot be influenced separately

19) GKM parameters ASPDIR (character tilt) not implemented

20) Only character spacing can be influenced

Report Command (R)

cursor position (P)	–
macrograph contents (M(<call letter>))	+
macrograph storage status (M(=))	+
character set (L)	–
error condition (E)	–
entering one_shot mode (I0)	–
entering multiple mode (I+)	–
report position interactive (P(I))	–

Polygon Fill Command (F) – 21)

9.3 Set-Up Features

The set-up configuration is based essentially on the VT340 original device (i.e. pagewise configuration of the various functionality sets, paging or direct branching is possible between the pages). The function extent of the VT340 Emulator includes the following set-up pages; only those features that can be modified on the basis of the existing hardware and software possibilities are included:

- MODE OVERVIEW
  - global settings
  - general settings
  - display
  - communications
  - keyboard
  - user-defined function keys
  - local editing
  - tab positions
  - colour rendition
  - erase display
  - call defaults
  - reset communications
  - language: German
- GLOBAL SETTINGS
  - online/local
- GENERAL SETTINGS
  - terminal mode
  - user-defined function keys
- DISPLAY
  - size of screen page
  - vertical scroll
  - blockwise scroll
  - status line
  - same/new line
  - automatic line justification
  - control character

21) Can be partly implemented via project-specific add-ons

- COMMUNICATIONS
  - host interface: data transfer rate
  - host interface: data flow control
  - host interface: character format
  - host interface: stop bits
  - printer interface: data transfer rate
  - printer interface: data flow control
  - printer interface: character format
  - printer interface: stop bits
  - local echo
- KEYBOARD
  - numeric field mode
  - arrow key mode
  - key <X]
  - decimal point in numeric field
- USER-DEFINED FUNCTION KEYS
  - erase all function keys
  - erase one function key
  - selected function key
- LOCAL EDITING
  - edit mode
  - erase mode
  - changeover edit mode
  - block transfer
  - transmit protected characters
  - transmit selected characters
  - transmit several areas
  - line transmission mode
  - end-of-transmission mode
  - VT131 transmission mode
  - space compression
- TAB POSITION
  - erase all tab stops
  - set all 8 column tab stops
- COLOUR RENDITION
  - call standard colour table
  - selected colour

9.4 Dual sessions

A session is the active connection between terminal and host**.**

The VT340 original device enables two sessions to be operated simultaneously. For the two sessions either two separate physical connecting lines are installed to one or two hosts or one physical connecting line with two logic channels (the Digitals Session Support Utility software SSU being used as protocol).

The switch session key is used to changeover from one session to the other. Reception of the characters arriving from the host and determined for the session that has just become passive is continued (no information gets lost).

This feature is not implemented.

9.5 Tektronix 4010/4014 emulator

9.6 Sixel programming

9.7 Using a mouse or tablet

9.8 Printing graphics

9.9 Project-specific add-ons

The term ”project-specific add-ons” covers those features not contained in the function set of the original device which, however, have proved necessary or useful in the application environment of the VT340 Emulator. These features include the following extensions:

- colour selection for the emulator in text mode
- hardcopy functionality
- starting and stopping the VT340 Emulator while operation is in progress
- bar diagrams
- filling the polygons

10 Description of Functions

The following Section contains a summary of those functions of the DEC Terminal VT340 that are of importance to the function set of the VT340 Emulator, i.e. the subset of the VT340 functionality in the VT340 Terminal Emulator is dealt with. The control sequences required to trigger the described functions are also listed to obtain a quick overview. For possible comments on the implementation of the various functions please refer to the overview given in Section 1 (footnotes).

This summary is based on the following documentation (see also Section 3):

- VT330/340 Programmer Reference Manual, Volume 1: Text Programming /1/
- VT330/340 Programmer Reference Manual, Volume 2: Graphics Programming /2/
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10.1 Text programming

10.1.1 Emulating VT series terminals

Selecting an Operating Level (DECSCL)

The control functions **CSI 6 2 ; 1 " p** or **CSI 6 3 ; 1 " p** select the VT300 mode with 7-bit control characters (default).

The control function **CSI 6 1 " p** selects the VT100 mode.

The control functions **CSI 6 2 " p**, **CSI 6 2 ; 0 " p**, **CSI 6 3 " p**, **CSI 6 3 ; 0 " p** or **CSI 6 3 ; 2 " p** select the VT300 mode with 8-bit control characters

Basically, control characters can be sent as 7-bit or 8-bit control sequences to the host.

In the "7-bit control characters" mode all 8-bit "C1 characters" are represented as their "7-bit code extension escape sequence" (e.g. the "control sequence introducer" **CSI** (8-bit) becomes **ESC [** (7-bit code extension)).

Select 7-bit C1 Control Characters (S7C1T)

The control function **ESC sp F** causes the terminal to transmit 7-bit control characters.

Select 8-bit C1 Control Characters (S8C1T)

The control function **ESC sp G** causes the terminal to transmit 8-bit control characters.

Selecting Character Sets

Basically, only the ASCII and the DEC special graphic character set are available. Moreover, these character sets can only be loaded into the left half (GL) of the possible character set repertoire.

A character set is loaded in two steps:

- Loading of the required character set into the logic character set repertoire (G0-G3)

  ESC (B loading of ASCII in G0
  ESC) B loading of ASCII in G1
  ESC * B loading of ASCII in G2
  ESC + B loading of ASCII in G3
  ESC (0 loading of DEC special graphic in G0
  ESC) 0 loading of DEC special graphic in G1
  ESC * 0 loading of DEC special graphic in G2
  ESC + 0 loading of DEC special graphic in G3

- Mirroring of the required character set previously loaded into the logic character set repertoire (G0-G3) into the accessible character set repertoire (in the case of the VT340 Emulator GL). As a result, the required character set is now available.

  SI (hex value = 0f) mirroring of G0 in GL (default value)
  S0 (hex value = 0e) mirroring of G1 in GL
  ESC n mirroring of G2 in GL
  ESC o mirroring of G3 in GL

  It is also possible to display in the preselected character block on the screen only the character following the command. To do this, the required character block must be available in G2 or G3:

  ESC N mirroring of G2 in GL (applies to the next character only)
  ESC 0 mirroring of G3 in GL (applies to the next character only)

  The exception here is that character sets loaded into G0 are immediately available in GL (step 2 not necessary).

10.1.2 Page memory

Set Lines per Page (DECSLPP)

This control function enables the size of the pages to be varied with the following possibilities being provided in the VT340 Emulator (See also the notes in the Appendix, if the size of the page memory has been configured to a maximum of 72 lines):

- **CSI 2 4 t** splits the page memory into 3 pages with 24 lines each
- **CSI 3 6 t** splits the page memory into 2 pages with 36 lines each
- **CSI 7 2 t** splits the page memory into 1 page with 72 lines

Origin Mode (DECOM)

DECOM determines whether or not positioning of the cursor is restricted by the top and bottom margins of the page:

- **CSI ? 6 l** enables the cursor to be moved also beyond the margins (default). The start point of the line numbering does not depend on the margins. The home position is defined as the top left corner of the screen.

- **CSI ? 6 h** prevents the cursor from being moved beyond the margins.
  The start point of the line numbering depends on the top margin. The home position is defined as the top left corner of the screen.

Set Top and Bottom Margins (DECSTBM)

The control function **CSI Pt ; Pb r** sets the top and bottom margin, **Pt** being the line number of the top margin and **Pb** being the line number of the bottom margin
(default: Pt = 1, Pb = number of lines per page).

10.1.3 Setting visual character attributes

Select Graphic Rendition (SGR)

The control function **CSI Ps ; Ps ... m** selects one or several character attributes. Each Ps number represents a specific attribute (default value = no attributes).

Ps	Attribute	Mode VT100	Mode VT300
0	all attributes off	x	x
1	bold	x	x
4	underline	x	x
5	blinking	x	x
7	negative image	x	x
8	invisible		x
22	bold off		x
24	underline off		x
25	blinking off		x
27	negative image off		x
28	invisible off		x

Double-Width, Double-Height Line (DECDHL)

Two consecutive lines with the same contents can be combined to form a double-height and double-width line using the control functions **ESC # 3** for the upper line and **ESC # 4** for the lower line. When using this feature with the VT340 Emulator, the following points should be taken into account.

- not possible in ”edit mode”
- output in main display
- only possible in replace mode, not in insert mode
- no indicator status line
- cursor not located on first screen line
- cursor located maximally on column 39

10.1.4 Editing and character protection

10.1.4.1 Editing

Erasure Mode (ERM)

The control function **CSI 6 l** causes the delete and insert functions (only ED, EL and ECH in ”interactive mode”, additionally IL, DL, ICH and DCH in ”edit mode”) to influence only unprotected characters (default).

The control function **CSI 6 h** enables the above-mentioned functions to influence protected characters as well.

The ”selective erase functions” (DECSED, DECSEL) are not influenced by this control function.

Insert/Replace Mode (RIM)

The overwrite mode is selected via the control sequence **CSI 4 l.** This means that the character at the cursor position in the page memory is replaced by the re-entered character (default). The control function **CSI 4 h** specifies the insert mode, i.e. the re-entered character is inserted at the cursor position in the page memory.

Delete Line (DL)

The control function **CSI Pn M** deletes Pn lines inside the scrolling region (i.e. within the margins of one page)

(default: Pn=1).

Space lines without attributes are inserted at the end of the scrolling region. DL is ineffective outside the scrolling margins.

Insert Line (IL)

The control function **CSI Pn L** inserts Pn space lines at the cursor position. Lines scrolled out of the page in this way are lost (default: Pn = 1).

Delete Character (DCH)

The control function **CSI Pn P** deletes Pn characters to the right of the cursor position. Blanks without attributes are inserted at the right end of the line (default: Pn = 1).

Insert Character (ICH)

The control function **CSI Pn @** inserts Pn blanks to the right of the cursor position. Lines scrolled out of the page in this way are lost (default: Pn = 1).

Erase in Display (ED)

The control function **CSI Ps J** erases parts of the screen or the whole screen irrespective of any page margins.

- Ps = 0: erases from the cursor to the end of the display (default).
- Ps = 1: erases from the start of the display up to the cursor.
- Ps = 2: erases the complete display.

Erase in Line (EL)

The control function **CSI Ps K** erases characters from the line in which the cursor is just located, irrespective of the current page margins:

- Ps=0: erases from the cursor to the end of the line (default).
- Ps=1: erases from the start of the line up to the cursor.
- Ps=2: erases the complete line.

Erase Character (ECH)

The control function **CSI Pn X** erases Pn characters right of the cursor position (default Pn = 1) irrespective of the page margins.

Selective Erase in Display (DECSED)

The control function **CSI ? Ps J** erases characters from the display that are marked erasable (see also character protection):

- Ps=0: erases from the cursor to the end of the display (default).
- Ps=1: erases from the start of the display up to the cursor.
- Ps=2: erases the complete display.

Selective Erase in Line (DECSEL)

The control function **CSI ? Ps K** erases from a line characters that are marked erasable (see also character protection):

- Ps=0: erases from the cursor to the end of the line (default).
- Ps=1: erases from the start of the line up to the cursor.
- Ps=2: erases the complete line.

10.1.4.2 Character protection

Independent Protection is supported in the VT340 Emulator. In this mode, all characters are protected irrespective of their primitive attributes (e.g. underlined, bold, etc.). Whether or not characters can be erased is determined by the current value of the erasure mode (ERM) (see also 10.1.4.1 Editing).

The following control functions define areas as ”independently protected”:

Select Character Protection Attribute (DECSCA)

CSI Ps ” q defines all following characters as either unprotected (PS = 0 or Ps = 2, default) or protected (Ps = 1).

Start Protected Area (SPA)

The control functions **SPA** and **ESC V** define the cursor position as the start of a series of protected characters.

End Protected Area (EPA)

The control functions **EPA** and **ESC W** define the cursor position as the end of a series of protected characters.

10.1.5 Local editing

Edit Mode (DECEDM)

The control function **CSI ? 1 0 l** selects the interactive edit mode (default). The terminal sends the entered characters directly to the host (interactive mode).

The control function **CSI ? 1 0 h** selects the local edit mode. The terminal stores all entered characters in the page memory. The characters are then transmitted to the host in block mode (edit mode).

Edit Key Execution Mode (DECEKEM)

Changeover between local and interactive edit mode is possible by pressing SHIFT-EDIT:

You preselect change of the edit mode immediately after SHIFT-EDIT has been pressed with control function **CSI ? 1 6 h** (default).

The control function **CSI ? 1 6 l** causes the terminal to transmit ”DECEDM” to the host immediately after SHIFT-EDIT has been pressed. The edit mode is not changed until the check-back signal has been received from the host.

If the terminal is in ”edit mode”, the amount of data sent to the host by the terminal depends on two factors:

10.1.5.1 Size of character block

As regards the size of the transport block there are three possibilities:

- VT131 partial page
  The text between the ”partial page marker” (fictitious identifier marking the last transmitted character, is placed by the terminal itself) and the cursor is transmitted.
- ANSI partial page
  The text located between the beginning of a selected area and the cursor is transmitted.
- Scrolling region
  A complete page (between top and bottom margin) is transmitted.

These parameters can be manipulated using the following three control statements:

Line Transmit Mode (DECLTM)

This control function defines the size of the block to be transmitted in local edit mode:

- **CSI ? 1 1 h** selects a whole line,
- **CSI ? 1 1 l** selects a complete page or parts of a page (depending on the current values of ”TTM” or ”DEC131TM”)

Transmit Termination Mode (TTM)

The control function **CSI 1 6 h** causes the entire scrolling region to be transmitted in page transmit mode (default).

The control function **CSI 1 6 l** causes a VT131 partial page or an ANSI partial page to be transmitted in page transmit mode (irrespective of DEC131TM).

VT131 Transmit Mode (DEC131TM)

CSI ? 5 3 h selects ”VT131 partial page” as the size of the transfer block.
CSI ? 5 3 l selects the ANSI partial page.

10.1.5.2 Selection of characters to be transmitted

The following control statements enable the user to select those characters that are to be transmitted within a block (see 2.1.5.1 for size of block):

Guarded Area Transfer Mode (GATM)

On block transfer, the control function **CSI 1 h** causes all characters (protected and not protected) to be transmitted to the host (default).

CSI 1 l means that only unprotected characters are transmitted to the host on block transfer.

Selected Area Transfer Mode (SATM)

CSI 1 7 h causes all characters (selected and not selected) to be transferred (default). The characters are selected via ”SSA” and ”ESA”.

CSI 1 7 l causes only selected characters to be transferred to the host.

Multiple Area Transfer Mode (MATM)

The control function **CSI 1 5 h** causes all selected areas on the page to be transferred in selected area transfer mode (default).

The control function **CSI 1 5 l** causes only the selected area in which the cursor is just located to be transferred.

Start Selected Area (SSA)

The control function **SSA** or **ESC F** marks the start of a selected area.

End Selected Area (ESA)

The control function **ESA** or **ESC G** marks the end of a selected area.

10.1.5.3 End-of-block character and space compression

Set Transmit Termination Character (DECTTC)

The control function **CSI Ps |** enables an end-of-block character to be selected, where:

- Ps=0: no EOB character (default).
- Ps=1: FF ... form feed
- Ps=2: ETX ... end of text
- Ps=3: EOT ... end of transmission
- Ps=4: CR ... carriage return
- Ps=5: DC3 ... XOFF

In its extended version, DECTTC enables a complete string to be specified as end-of-block marking:

CSI ? Pni ; ... Pn6 | .

Here, Pni corresponds to the decimal value of the required character (e.g. ESC in ASCII code 11H equivalent to the decimal value 27).

Transmit Line Termination Characters (DECTLTC)

The control function **CSI ? Pn ; ... Pn6 ' s** enables an end of line character sequence to be determined which the terminal sends to the host after each transmitted line. Here, the Pni correspond to the decimally coded characters (default: CR = 13).

Space Compression Mode (DECSCFDM)

The control function **CSI ? 1 3 l** causes the characters (including spaces) to be displayed on the screen as they are being transmitted (default).

The control function **CSI ? 1 3 h** prevents spaces between character fields from being transmitted.

The end of transmission of a character field is marked by the record separator RS.

The end of the last character field of a complete line is marked by the transmit termination character defined via ”DECTTC”

Transmit Execution Mode (DECTEM)

The control function **CSI ? 1 4 h** causes the block to be sent to the host immediately after ENTER has been pressed, provided edit mode is active at that time (default).

The control function **CSI ? 1 4 l** causes an inquiry to be sent to the host after ENTER has been pressed to find out whether or not it is ready to receive. The block is not transmitted until a positive acknowledgement is received.

Set Transmit State (STS)

The **ESC S** sequence is sent to the host by the terminal to find out whether or not it is ready to receive (see also ”DECTEM”).

Transmit (DECXMIT)

The host sends the sequence **ESC 5** to STS as positive acknowledgement. The terminal can now send a block to the host.

10.1.6 Cursor movement and panning

Text Cursor Enable Mode (DECTCEM)

The control function **CSI ? 2 5 h** makes the cursor visible.

CSI ? 2 5 l causes the cursor to disappear.

Cursor Position (CUP)

The control function **CSI P1 ; Pc H** moves the cursor to line P1 and column Pc.

Horizontal and Vertical Position (HVP)

The control function **CSI P1 ; Pc f** moves the cursor to line P1 and column Pc. (causes the same action as ”CUP”).

Cursor Forward (CUF)

The control function **CSI Pn C** moves the cursor Pn columns to the right.

Cursor Backward (CUB)

The control function **CSI Pn D** moves the cursor Pn columns to the left.

Cursor Up (CUU)

The control function **CSI Pn A** moves the cursor Pn lines upward.

Cursor Down (CUD)

The control function **CSI Pn B** moves the cursor Pn lines downward.

Vertical Cursor Coupling Mode (DECVCCM)

The control function **CSI ? 6 1 h** causes the user window to be panned to ensure that the cursor remains visible if it is moved beyond the upper or lower window margin (default).

The control function **CSI ? 6 1 l** causes the cursor to be decoupled from the display in the case of vertical movements. The cursor disappears if it is moved beyond the upper or lower margin of the user window.

10.1.7 Keyboard, printing and display commands

Keyboards Action Mode (KAM)

The control function **CSI 2 h** locks the keyboard. The terminal ignores all keyboard entries sending characters to the host.

”KAM” does not influence the set-up key.

The control function **CSI 2 l** unlocks the keyboard (default).

Backarrow Key Mode (DECBKM)

The control function **CSI ? 6 7 h** causes the terminal to send a BS (back space) character to the host after the backspace key (<X] key) has been pressed.

CSI ? 6 7 l causes the terminal to send a DEL (delete) character to the host after the back space key has been pressed (default).

Line Feed/New Line Mode (LNM)

The control function **CSI 2 0 h** causes the terminal to send the character combination CR (carriage return) LF (line feed) to be sent to the host after the RETURN key has been pressed. The cursor is positioned on the first column of the following line, if the terminal receives LF (line feed), FF (form feed) or VT (vertical tab) from the host.

The control function **CSI 2 0 l** causes the terminal to send only the CR character (carriage return) to the host after the RETURN key has been pressed (default). If the terminal receives LF, FF or VT, the cursor is moved to the following line, the column position remaining unchanged.

Autowrap Mode (DECAWM)

The control function **CSI ? 7 h** selects the autowrap mode. If the cursor is positioned at the right margin of the page, received characters appear at the start of the next line.

CSI ? 7 l deselects the autowrap mode. If the cursor is located at the right margin of the page, the characters located at this place are overwritten by newly received ones (default).

Cursor Keys Mode (DECCKM)

The control function **CSI ? 1 h** has the effect that the actuation of the cursor keys causes application-oriented characters to be transmitted.

CSI ? 1 l causes ANSI cursor sequences to be sent to the host on actuation of the cursor keys (default).

Keypad Application and Numeric Modes (DECKPAM/NM)

The control function **ESC =** enables application-oriented character sequences to be transmitted by operating the keys on the numeric keypad.

The control function **ESC >** causes the characters shown on the keys to be transmitted on actuation of the numeric keypad (default).

Nuumeric Keypad Mode (DECNKM)

This control statement invokes the same reactions of the terminal as the previously described ”DECKPAM/NM” sequence with the ”DECNKM” sequence mentioned here only being available in VT300 mode. The following correspond with one another:

CSI ? 6 6 h ... ESC=
CSI ? 6 6 l ... ESC > (default)

User-Defined Keys (DECUDK)

The full keyboard used on the SINUMERIK 880 has 14 function keys. ”DECUDK” offers the possibility of defining the character sequences transmitted on actuation of the function keys:

DCS Pc ; Pl | Ky1 / St1 ; ... Kyn / Stn ST, with the parameters having the following meaning:

- Pc = 0: All key definitions are erased for the time being (default).
- Pc=1: Only those key definitions that are redefined are erased.
- Pl=0: Locks the key definitions, redefinition only possible via set-up.
- Pl=1: Redefinition is possible by means of DECUDK (default).
- Kyi: One of the keys (F6..F14, Help, Do). The remaining keys have specific local functions and cannot be defined by the user.
- Sti: Hexadecimally coded character sequence.
- ST: String terminator (ESC ****)

A maximum memory space of 256 bytes is available for the 15 user-defined keys. The unassigned memory space available at a given time is allocated on the basis of ”first come first served”. If the entire memory space is assigned, keys cannot be defined until memory space is available again (e.g. by erasure or by redefining other user-defined keys).

Local Echo: Send/Receive Mode (SRM)

The control function **CSI 1 2 h** deselects the local echo (default).

The control function **CSI 1 2 l** selects the local echo. In this case, the characters entered via the keyboard are displayed on the screen without an extra host activity being required to send them to the terminal.

The 25th screen line is reserved for the status line. This marked line can be used in two ways:

- Indicator status line: Information on the status of the terminal (one or two sessions, current page number, position of text cursor, etc.)
- Information can be written into the line by the host: The status line contains application-oriented data and messages from the host.

Application-oriented data can be transmitted to the status line by either of the two following statements:

Select Active Status Display (DECSASD)

The control function **CSI Ps $ }** determines where data are sent by the terminal.

- Ps = 0: To the main display, corresponding to the lines 1-24 (default)
- Ps = 1: To the status line

Select Status Display Type (DECSSDT)

CSI Ps $ selects the type of status line:

- Ps = 0: No status line (25th line empty)
- Ps = 1: Indicator status line (default)
- Ps = 2: Status line into which information can be written by the host.

10.1.8 VT300 reports

Reports are used to send information on the terminal to the host on request. Of the numerous possible reports the following are implemented in the VT340 Emulator:

Terminal Identification (DECID)

Considering the fact that DEC do not recommend the use of this command (incompatibility with other DEC terminals), the ”Primary DA (Device Attributes) Request” is implemented in the VT340 Emulator for implementing these functions.

The terminal sends a primary DA response following the host request **CSI c** or **CSI 0 c**:

CSI ? Psc ; Ps1 ; ... Psn c

where the parameters have the following meaning:

- Psc: = 61 ... operating level 1 (VT100)
  63 ... operating level 3 (VT300)
- Psn indicates the extensions supported by the terminal (the notes in parentheses indicate whether or not the features are possible, available or implemented in the VT340 Emulator):

  1 ... 132 columns (not possible with VT330/340)
  2 ... Printer port (not available)
  3 ... ReGis graphics
  4 ... Sixel graphics (not implemented)
  6 ... Selective erase
  7 ... Soft character set (not available)
  8 ... User-defined keys
  9 ... National replacement character sets (not available)
  13 ... Local editing mode
  15 ... Technical character set (not available)
  16 ... Locator device port (not available)
  18 ... Windowing capability (not possible)
  19 ... Dual sessions (not implemented)

This means that the response to a primary DA request of the host from the VT340 Emulator has the following configuration:

CSI ? 61 bzw. 63; 3; 6; 8; 13; c

Cursor Position Report (CPR)

In response to a host request on the **CSI 6 n** sequence the terminal sends a ”CPR”:
CSI Pl; Pc R where PI is the current line number and Pc the current column number.

User Defined Keys

By means of the sequence **CSI ? 25 n**, the host asks the terminal whether or not the user-defined keys are locked (see also DECUDK user-defined keys). The terminal sends as response:

CSI ? 20 n ...	user-defined keys are not locked
CSI ? 21 n ...	user-defined keys are locked

Cursor Information Report (DECCIR)

The host requests information on the current cursor position using the request presentation state report **CSI 1 $ w** (DECRQPSR). As a result, the terminal sends a ”DECCIR”:

DCS 1 $ u Pr ; Pc ; Pp ; Srend ; Satt ; Sflag ; Pgl ; Pgr ; Scss ; Sdesig

where:

- Pr: Line number in which the cursor is located
- Pc: Column number in which the cursor is located
- Pp: Number of current page
- Srend: 8-bit codes specifying the current visual write attributes (bold, underlined, etc.)
- Satt: 8-bit codes specifying the current erase attributes
- Sflag: 8-bit codes specifying the current modes and internal states (e.g. origin mode)
- ST: String Terminator (ESC\)

The other parameters (Pgl, Pgr, Scss and Sdesig) are irrelevant to the emulator because only one character set (ASCII) is used.

Save Cursor (DECSC)

The control function **ESC 7** saves the cursor position and the internal state of the terminal (visual write attributes, origin mode, etc.).

Restore Cursor (DECRC)

ESC 8 restores the terminal to the state it was in at the time the function ”DECSC” was executed.

Request Displayed Extent (DESRQDE)

The host uses the sequence **CSI ” v** to request information on how much of the current page is displayed on the screen. The terminal sends a ”DECRPDE” as response.

Report Display Extent (DECRPDE)

The terminal sends the following sequence as response to a ”DECRQDE”:

CSI Ph ; Pw ; Pml ; Pmt ; Pmp ” w

where:

- Ph: Number of lines displayed in the window
- Pw: Number of columns displayed in the window
- Pml: Number of columns located at the left window margin
- Pmt: Number of the line located at the top window margin
- Pmp: Number of the currently displayed page

10.1.9 Resetting the terminal

Soft Terminal Reset (DECSTR)

The control function **CSI ! p** sets the terminal characteristics to the default values at the time of Power On.

Tab Clear (TBC)

CSI Ps g clears the tab stops where:

- Ps = 0: Only the stop with cursor is cleared (default)
- Ps = 3: All stops are cleared.

10.2 Graphics programming

This Section deals with the graphics rendition in the VT340 Emulator. Considering the partial incompatibility between the original hardware of the VT340 and the SINUMERIK 880 operator panel on which the VT340 Emulator is run, discrepancies in behaviour may occur between the emulator and the original device.

The description of the rather comprehensive functions has been deliberately condensed because the main objective is to focus the readers attention on the discrepancies between the original device and the VT340 Emulator. A detailed description of the various functions is contained in the documentation on the original device.

10.2.1 Entering and exiting ReGis

ReGis is a DEC command set used to implement graphics on the VT340. Complex pictures can be composed from simple geometric shapes (lines, circles, angles, etc.) using ReGis. In addition, text characters and shades can be defined.

In order to use this command set, the user must enter ReGis. Several possibilities are available to do this:

ReGis is entered via **DCS 1p** or **ESC P1p** and started with a new command.

ReGis is entered at the place where it was first exited using **DCS 2 p** or **ESC P2p**. In addition, the commands are also logged in the last line.

ReGis is started with a new command via **DCS 3 p** or **ESC P3p.**
In addition, the commands are also logged in the last line.

The ReGis mode is quit by means of **St** or **ESC \.**

10.2.2 Screen control command

Output Mapping Control S (M)

The background colour is always composed from colour plane 0 and the write colour from colour plane 7. Using this command it is now possible to parameterize the 16 available colour planes (plane 0 to plane 15) according to the desired or required values. Two procedures are available to the user to do this:

- Specification of the required colour via **RGB (= red, green, blue)**. In this case, a maximum of 8 different colours are possible which are addressed by the relevant code letters:

  D ... dark
  R ... red
  G ... green
  B ... blue
  C ... cyan (between blue and green)
  Y ... yellow (between red and green)
  M ... magenta (between red and blue)
  W ... white

- Specifications in **HLS (= hue, lightness, saturation)**. With these specifications, 4096 different colours can be implemented and selected by the user. For the relevant values the following upper limits apply:

  hue ... 0 to 360 degrees
  lightness ... 0 to 100 percent
  saturation ... 0 to 100 percent

In order to show the correlation between these two colour systems, the default values for the various colour planes as implemented in the VT340 Emulator are listed below. The colour specifications are based on both systems:

Colour plane	Colour	HLS values			RGB values		
		H	L	S	R	G	B
0	black	0	0	0	0	0	0
1	blue	0	50	60	20	20	80
2	red	120	46	72	80	13	13
3	green	240	50	60	20	80	20
4	magenta	60	50	60	80	20	80
5	cyan	300	50	60	20	80	80
6	yellow	180	50	60	80	80	20
7	white 100%	0	100	0	100	100	100
8	gray 50%	0	57	0	57	57	57
9	blue	0	46	29	33	33	60
10	red	120	43	39	60	26	26
11	green	240	46	29	33	60	33
12	magenta	60	46	29	60	33	60
13	cyan	300	46	29	33	60	60
14	yellow	180	46	29	60	60	33
15	gray 80%	0	80	0	80	80	80

The default red intensity for colour plane 6 can now be specified in two ways:
S (M6 (AR)) or S (M6 (AH120L46S72)).

More complex mixed colours can only be selected via HLS values, e.g. turquoise for colour plane 12: S (M12 (AH300L80S60))

Screen Erase S (E)

Sets the entire screen to background colour.

Graphics Cursor Control S (C)

Influences the shape and visibility of the cursor. Considering the hardware possibilities of the SINUMERIK 880 operator panel (fixed crosshair cursor) only the visibility can be influenced.

The following applies:	graphics cursor off (cursor not visible)	S (C0)
	graphics cursor on (cursor not visible)	S (C1)

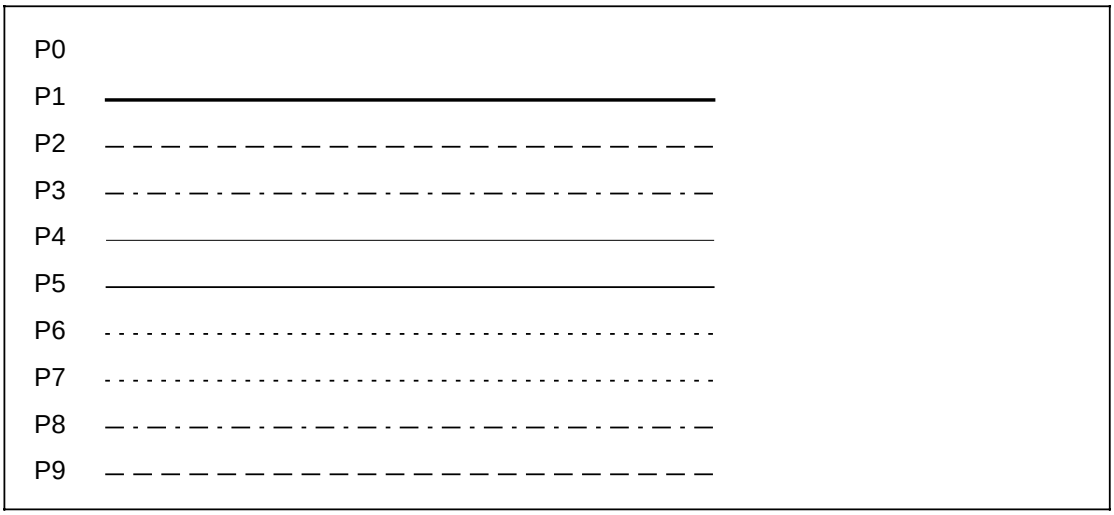
10.2.3 Write control command

PV Multiplication W (M)

Enables a multiplication factor for pixel vectors to be specified.

Pattern Control W (P)

Ten 8-bit memory cells contain the image of lines and shaded surfaces in coded form. Considering the limited possibilities provided by the hardware interface, this option enables one of the ten standard patterns to be selected in the VT340 Emulator.



Foreground Intensity W (I)
This option enables the foreground colour to be selected. This specification can be made in three different ways:

- Direct specification of the colour plane
  e.g. W (15) for selecting plane 5
  In this case, the colour of the relevant colour plane is written. The colour of this plane can be varied by the user within a wide colour spectrum using the screen control command (see also 2.2.2)
- Specification of the required colour in RGB or HLS values
  e.g. W (I(G)) or W (I(H240L50S60)) for green.
  For selecting the colour the same applies as in the case of colour determination for the colour planes, i.e. 8 different colours are possible with RGB values and 4096 colours with HLS values.

  The general rule, however, is that when selecting a colour value not covered by a colour plane, an approximation is carried out to the desired colour, i.e. the colour plane best suited to meet the user´s requirements is selected. If the specified colour and the possible colour values in the 16 planes are to much apart, random assignments may be the result.

Plane Select Control W (F)

This option enables the writing rights to be directed to the various colour planes (four different planes in the case of the VT340). Each pixel displayed on the physical screen is therefore formed in its colour composition from a 4-bit code, each of the pixels corresponding to one plane. This 4-bit code selects only one of the 16 possible colours stored in the colour planes. The access rights to the various colour planes can now be masked via the values transferred together with ”plane select”, i.e. which of the colour planes are allowed to take part in the colour formation of the pixel and which not.

The following list gives an overview of the correlation between ”plane select” and the selected colour plane(s).

W (F0)	none
W (F1)	plane 0
W (F2)	plane 1
W (F3)	planes 0, 1
W (F4)	plane 2
W (F5)	planes 0, 2
W (F6)	planes 1, 2
W (F7)	planes 0, 1, 2
W (F8)	plane 3
W (F9)	planes 0, 3
W (F10)	planes 1, 3
W (F11)	planes 0, 1, 3
W (F12)	planes 2, 3
W (F13)	planes 0, 2, 3
W (F14)	planes 1, 2, 3
W (F15)	all planes

Writing Styles W (V, R, C or E)

Bits set to one in the pattern memory correspond to ”write” in foreground colour and bits set to zero correspond to ”write” in background colour.

- **W (V)** selects **Overlay Writing**, only those bitmap positions to be written in foreground colour are influenced.
- **W (R)** selects **Replace Writing**, writing is both in foreground colour (1 in the pattern memory) and in background colour (0 in the pattern memory).
- **W (C)** selects **Complement Writing**, the content of the bitmap positions to be written in foreground colour (1 in the pattern memory) is complemented. The content of the bitmap positions to be written in background colour remains unchanged.
- **W (E)** selects **Erase Writing**, the content of the pattern memory is ignored. The entire line is written in background colour (negative pattern control off) or foreground colour (negative pattern control on).

This feature is implemented in accordance with the function extent of the underlying hardware interface.

10.2.4 Position Command

Absolute Position P [X, Y] or P [X] or P [,Y]

Positions the cursor to the x, y coordinates.

Relative Position P [+/–X, +/–Y] or P [+/–X] or P [,+/–Y]

Adds or subtracts the current values for x and y to (from) the temporary cursor coordinates. The resulting x and y values determine the new cursor position.

Absolute/Relative Position P [X,+/–Y] or P [+/–X, Y])

Enables the absolute and relative coordinates to be combined to determine the new cursor position.

Pixel Vector Offet Position P <PV value>

The new cursor position is determined by a sequence of pixel vectors.

Bounded Position Stack P (B)<embedded options> (E)

A position stack is a sequence of positions in the x/y coordinate system. The cursor is moved consecutively from one position to the next. Between the pairs of coordinates any other ReGis functions may be located. With the ”bounded position stack”, the cursor is reset to the initial position at the end.

Unbounded position Stack P (S)<embedded options> (E)

The cursor remains on the last position specified and is not reset to the initial position.

10.2.5 Vector command

VT340 original device:
The ”Temporary write command” is not implemented.

draw dot V [ ]

Draws a dot (single pixel) on the current cursor position.

draw line V [X, Y]

Draws a straight line starting at the current cursor position to the dot with the coordinates x, y (both absolute and relative values can be specified). When specifying a sequence of pixel vectors, the line runs along the vectors in accordance with the current multiplication factors.

bounded position stack V (B)<embedded options> (E)

Supports the drawing of closed polygon curves.

unbounded position stack V (S)<embedded options> (E)

Supports the drawing of open polygon curves.

10.2.6 Curve command

circle with center at current position C

Draws a full circle with centre = current cursor position. [x, y] is a point on the circular arc (centre point coordinates can be specified as absolute or relative values). PV is a sequence of pixel vectors determining the radius of the circle.

circle with center at specified position C (C)

Draws a full circle with the current cursor position being located on the circular arc. [x, y] are the absolute or relative coordinates of the circle centre. The circle centre can also be determined via PV.

arc with center at current position C (A<deg>)

Draws a circular arc with centre = current cursor position. DEG specifies the length of the circular arc in full degrees. Negative values mean clockwise traversing and positive values counterclockwise traversing. [x, y] represents the start point of the circular arc and can be specified with absolute or relative values or via PV. On completion of the action, the cursor is located in the centre again.

arc with center at specified position C (A<deg>C)

Draws a circular arc with centre [x, y] (addressing is possible in the same way as above). The start point of the circular arc is the current cursor position. On completion of the action, the cursor is located at the end of the circular arc.

The two following spline functions are implemented in the VT340 Emulator by straight lines between the individual points.

closed curve sequence (spline) C (B) <positions> (E)

Connects a sequence of points by a closed polygon function curve.

open curve sequence (spline) C (S) <positions> (E)

Connects a sequence of points by an open curve.

10.2.7 Text command

character spacing T <position>

"Position" is a relative x, y pair indicating where the cursor is positioned prior to drawing the next letter.

size options T (S)

Permits enlargements by integer factors between 1 and 16.

When using the "text commands", the general rule is that differences between the hardware base of the original device and the base on which the VT340 Emulator is run must be taken into account. Particular attention should be paid to the following special points.

- The height of the character cells in pixels differs, i.e. in the case of text enlargements the type size is different for the original device and the VT340 Emulator.
- On the original device the **top** left corner is used as letter base, on the emulator the **bottom** left corner.

10.2.8 Macrographs

Define Macrograph @: <call letter> <definition>@;

A sequence of ReGis ”definition” commands is stored under the name ”call letter” (one letter) in much the same way as a subroutine replacing it.

Invoke Macrograph @ <call letter>

The content of an already defined macro named ”call letter” (one letter) is used in place of this command.

Clear Macrograph @: <call letter>@;

”call letter” is cleared. The command @ clears all macros.

10.2.9 Report command

Reports are used to supply the host with information on the terminal on request. For graphic emulation, the following reports have been implemented in the VT340 Emulator.

Macrograph Contents R (M(<call letter>))

The host requests the contents of the macros specified by ”call letter” using this command. The terminal then sends the ”macrograph contents report” to the host. This report has the following configuration:

@ = <call letter> ... Macrograph report indicator (macrograph contents)
@; <CR> ... Macrograph terminator

Macrograph Storage Status R (M(=))

As response to this host request the terminal sends an integer string having the following configuration ”aaaa,tttt”

- aaaa ... Memory area still available for macrographs
- tttt ... Total memory area available for macrographs

10.3 SINUMERIK-specific features

This Section contains a description of the SINUMERIK-specific features implemented in the VT340 Emulator. These features are not contained in the function extent of the original device. This makes it possible with certain restrictions to run the same application both on the DEC original device and on the VT340 Emulator because, on the one hand, the original device does not ”understand” the emulation-specific sequences and, on the other hand, the VT340 Emulator skips those functions of the original device it does not make available.

10.3.1 Colour selection

The colours listed below are selected via the control sequence **`CSI 3;colour code m`**. These colours are selected in accordance with the possibilities of the colour planes, i.e. if the required colour cannot be selected in any of the 16 colour planes, it is approximated. In the case of major differences between the selected colour and the possible colour values in the planes, this may lead to purely random colour selection in the VT340 Emulator.

Colour code	…	Colour
0		black
1		red
2		green
3		yellow
4		blue
5		magenta
6		cyan
7		white

This function is an extension of the ”Select Graphic Rendition (SGR)” function.

10.3.2 Hardcopy functions

A hardcopy of the screen is output at the second serial interface when operating the F2 key, if a printer has been configured as a peripheral device. Access is only possible to text information, i.e. graphics is not represented. <CR> <LF> is transmitted at the end of each line and <FF> at the end of output.

10.3.3 Starting and stopping the VT340 emulator in running operation

The emulator is stopped by pressing the basic display key. As a result, the VT control section is terminated and the momentary current state of the function parameters of the VT340 Emulator is saved in the interpreter. Pin-point locating on cold restart is only possible if the following points are taken into account:

- Abort not possible while the emulator is in SETUP mode
- No abort during the local edit mode, because the page memory cannot be saved prior to aborting the VT control task due to the high memory space required
- No abort in ReGis mode due to the nesting depth of the ReGis interpreter.

If an attempt is made in one of these modes to stop emulation, an error message appears on the screen. This error message disappears if the key is pressed a second time.

10.3.4 Bar charts

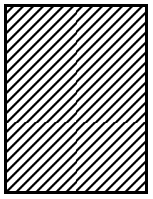
The following calls have been implemented in the graphics mode as an extension of the ”Write Control Commands” to facilitate the drawing of bar charts with different filling patterns.

The following two commands specify the opposite corner points (bottom left, top right) of the bar. It is possible to specify either both points or the top right point only.

W (B [x1, y1] [x2, y2]) and **W (B [x2, y2])**

The following call is used to specify the filling pattern. As pattern specifications only numbers between 0 and 15 (corresponding to the patterns implemented in the SINUMERIK graphics basic system) are evaluated.

W (A(0<f<15))



10.3.5 Filling of polygons

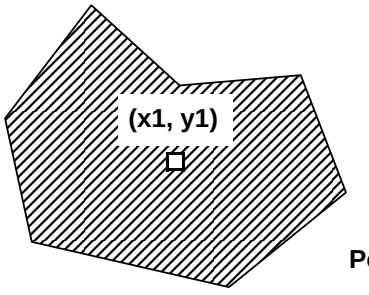
This project-specific feature enables the user to fill a closed line definition. The following points should be observed:

- As filling colour only the colour can be selected that has also been used for drawing the line.
- DThe object to be filled must be completely visible on the screen.
- Filling patterns as used for the bar diagrams are not possible.

The call used to fill a polygon has been implemented in the ReGis mode as an extension of the ”Write Control Commands” and has the following configuration:

W (U [x1, y1])

x1, y1 defines the coordinates of a point inside the line definition to be filled.



10.4 Internally used CSI sequences

In the VT340 Emulator, the following user-defined CSI sequences are used for the internal process or internal communication:

CSI 1 a
CSI 2 a
CSI 3 a
CSI 4 a
CSI 5 a
CSI 6 a

These sequences do not exist in the function spectrum of the original device and must not be entered by user programs or via the keyboard (in local mode and local edit mode).

11 References

1. VT330/VT340 Programmers Reference Manual
   Volume 1: Text Programming
   Digital Equipment Corporation, USA
   March 1987

2. VT330/VT340 Programmers Reference Manual
   Volume 2: Graphics Programming
   Digital Equipment Corporation, USA
   March 1987

3. Installing and Using The VT330/VT340 Video Terminal
   Digital Equipment Corporation, USA
   March 1987

4. VT330/VT340 Programmer Pocket Guide
   Digital Equipment Corporation, USA
   March 1987

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