



INSTRUMENTATION DIAGNOSTICA
Technical Product Management and Service

Boehringer Mannheim GmbH
Enzymun-Test® Analyzer Systems
HOST Interfaces

Specifications for Bidirectional Data Transmission

Version 2.0 -Nov.1994
Mat.#: 1 400 258 001

Number of pages: 60
ESHIF-V2.DOC/PC

Document: ESHIF-V2.DOC
Author: Dr.-Ing. Peter Centner
Creation Date: April 10, 1994
Printed: November 26, 1997

Copyright © 1992-1994
Dr.-Ing. Peter Centner
Boehringer Mannheim GmbH

Table of Contents

Topic Page

1. Introduction	1
2. Interface Hardware	4
2.1. Second Serial Port for Host Communication	4
2.2. Connection Cable	10
2.2.1. 3-Wire-Connection-Cable	10
2.2.2. Null-Modem-Cable	11
2.3. Hardware Test	12
3. Computer Software Setup	13
3.1. Setup TWIN for ES300/600/700	13
3.1.1. TWIN: Setup of Communication Parameters	13
3.1.2. TWIN: Download	20
3.1.3. TWIN: Upload	21
3.1.4. TWIN: System Status Assignment	22
3.1.5. TWIN: Trace	25
3.2. Setup MSTEP for ES33	26
3.2.1. MSTEP Setup of Communication Parameters	26
3.2.2. MSTEP: Download	29
3.2.3. MSTEP: Upload	31
3.2.4. MSTEP: Trace	33
4. Software Protocol	34
4.1. Code and String Structures	34
4.2. Protocol Structure	40
4.2.1. Control Protocol for Sending Data	40
4.2.2. Control Protocol for Receiving Data	43
4.3. Data Set Structure	44
5. Examples	53
5.1. Definitions	53
5.2. ES300	54
5.2.1. ES300 Operated in Master Mode	54
5.2.1.1. ES300: Master Mode - Download Trace	54
5.2.1.2. ES300: Master Mode - Upload Trace	55
5.2.2. ES300 Operated in Slave Mode	58

Topic	Page
5.2.2.1. ES300: Slave Mode - Download Trace (First Option)	58
5.2.2.2. ES300: Slave Mode - Download Trace (Second Option)	59
5.2.2.3. ES300: Slave Mode - Upload Trace	60
5.3. ES33	62
5.3.1. ES33 Operated in Master Mode	62
5.3.1.1. ES33: Master Mode - Download Trace	62
5.3.1.2. ES33: Master Mode - Upload Trace	62
6. List of Figures and Tables	65

1. Introduction

This manual contains the specifications for bidirectional data transmission between an **ES Analyzer System** by Boehringer Mannheim GmbH and a laboratory host system. The hardware components required as well as the transfer procedures on the relevant communication levels are described. They highlight the general considerations to be taken into account in any approach to realize the data communication between different computer systems.

This specification illustrates the fundamental considerations for the host link and contains information concerning the following:

- Hardware
 - What interface hardware is required?
 - How is the physical connection established?
- Use and control of the data transmission
 - How to set the transfer and communication parameters?
 - What is the formal structure of the strings and values to be transmitted and what influence can you take on it?
 - What kind of data or variables can be transmitted?
 - How and by which system is the data transfer initiated?
- Software protocol
 - What does the transmission protocol used for communication between the two systems look like?
 - What does the host at the other end of the data link do and what rules has the program at the host link to follow?

Working with the **ES HOST Interface** you will find that the data transfer from the host computer to the **ES Analyzer System** can be done in a very easy, comfortable and reliable way. **Figure 1.1** and **Figure 1.2** illustrate the basic concept of the communication procedure between an **ES Analyzer System** and the laboratory host system.

This interface document is also valid for all other ES Analyzer Systems (autoloader option included) running with TWIN software. In this document ES300 stands as a representant for all ES Analyzer Systems ES300, ES600 or ES700.

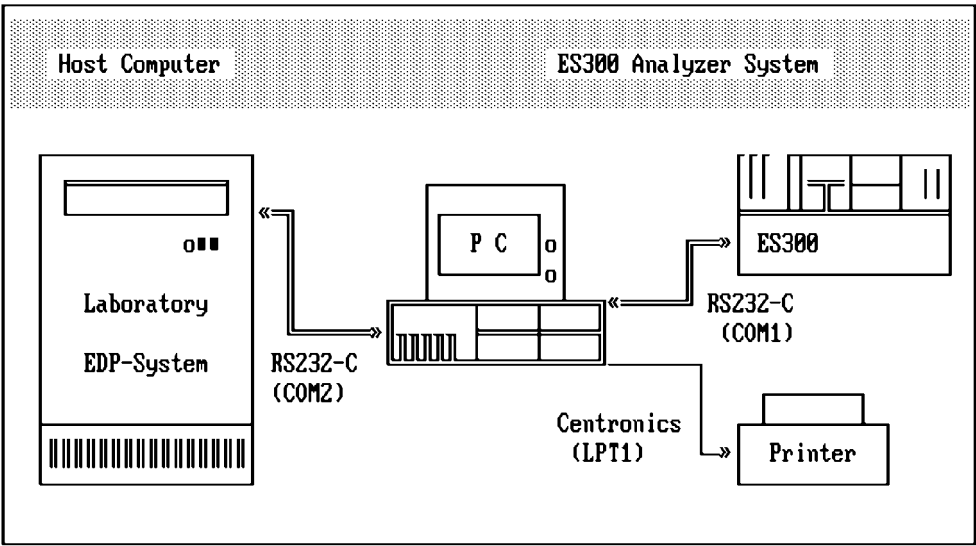


Figure 1.1: ES300 host communication concept.

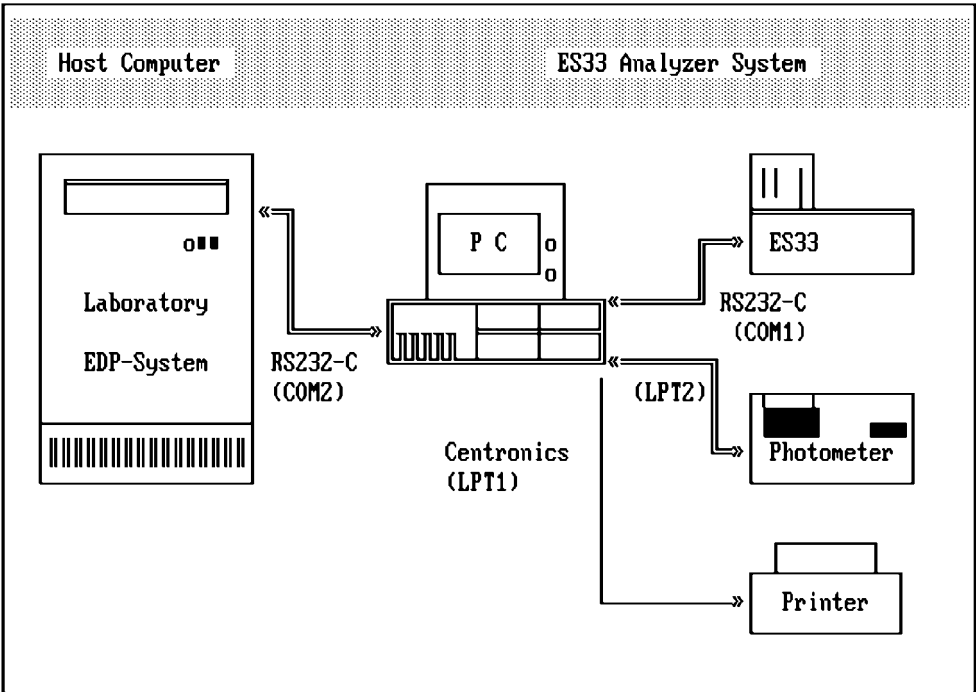


Figure 1.2: ES33 host communication concept.

In this manual the **ES300** represents all **ES Analyzer Systems 300/600/700** which are running with the TWIN software.

New **ES HOST Interface** features introduced until January 1994 are included.

If problems with the installation or questions about the transfer should arise please contact the responsible person of Boehringer Mannheim Service Department or directly the Service Management of the Central Marketing Department of Boehringer Mannheim GmbH (Germany):

**Boehringer Mannheim GmbH
Technical Product Management
Data Technique**

**Sandhofer Straße 116
D-68305 Mannheim
Phone: (49) 621 / 759-4204
Telefax: (49) 621 / 759-4394**

2. Interface Hardware

2.1. Second Serial Port for Host Communication

The data is transmitted via serial interfaces in accordance with the V.24/RS232-C standards. The first communication port of the ES personal computer (**COM1**) will be needed for the communication between the user software (**MSTEP** for ES33 with the MS-DOS operating system; **TWIN** for ES300 with the QNX operating system) and the **ES Analyzer System**. Therefore, the connection between the ES personal computer and the host system requires a second communication port (**COM2**).

Normally the personal computer delivered with your **ES Analyzer System** should be provided with the correct number of input/output interfaces (I/O ports).

Depending on the degree of equipment (autoloader, barcode reader) there are up to five serial interfaces (analyzer, host, barcode reader, autoloader, modem) and one parallel interface (printer) for the **ES300-computer** and two serial interfaces (analyzer, host) and two parallel interfaces (photometer, printer) for the **ES33-computer**.

Definition:

ES300: **QNX** is the Quantum realtime multitasking and multiuser operating system running the **TWIN software**. **TWIN** is the application software used to control the ES300 analyzer.

ES33: **MS-DOS** is the Microsoft disk operating system running the **MSTEP software**. **MSTEP** is the application software used to control the ES33 analyzer.

If the number of I/O ports is not sufficient please add the additional interface board to a free slot of your ES computer. Refer to the instruction manuals of the interface board and/or the computer to set the I/O-ports to the correct port addresses and interrupt request lines (IRQ).

In case a interface is built in physically but not recognized by the operating system, check if the port addresses and the interrupt request lines are set correctly. **Tables 2.1a-c** show the required settings for the recommended XPORT3-BM (ID#1562002) which provides three additional serial ports with only one interrupt request line.

In the case your computer has two serial ports by default and is equipped with a older XPORT3 we recommend to disable the second internal port (2F8H) and to use that of XPORT3.

Note: **COM3** and **COM4** or a fifth port **COM5** are not recognized automatically by DOS, but need special installation and drivers for DOS. This is not necessary while the QNX operating system is running.

QNX is **not able** to run serial interface boards with **IRQ10** or **IRQ11** as used by the HP serial interface adapter for COM3 and COM4. Only IRQ levels less than eight can be used with the operating system QNX.

Serial Port	QNX-name	Source	Address	IRQ	Comment
COM1	\$mdm	PC	03F8h	IRQ 4	instrument control
COM2	\$term1	PC	02F8h	IRQ 3	host communication
COM3	\$term2	XPORT3	03E8h	IRQ 5	barcode reader
COM4	\$term3	XPORT3	02E8h	IRQ 5	autoloader control
COM5	\$term4	XPORT3	02E0h	IRQ 5	remote access
<div> <div>1 2 3 4 5 6</div> <div> <div></div><div></div><div></div><div></div><div></div><div></div> </div> <div>Off</div> <div> <div></div><div></div><div></div><div></div><div></div><div></div> </div> <div>On</div> </div>					

Table 2.1a: Addresses and interrupts of two default serial interfaces and XPORT3-BM.

Serial Port	QNX-name	Source	Address	IRQ	Comment
COM1	\$mdm	PC	03F8h	IRQ 4	instrument control
COM2	\$term1	XPORT3	03E8h	IRQ 3	host communication
COM3	\$term2	XPORT3	02E8h	IRQ 3	barcode reader
COM4	\$term3	XPORT3	02E0h	IRQ 3	autoloader control or remote access
<div> <div>1 2 3 4 5 6</div> <div> <div></div><div></div><div></div><div></div><div></div><div></div> </div> <div>Off</div> <div> <div></div><div></div><div></div><div></div><div></div><div></div> </div> <div>On</div> </div>					

Table 2.1b: Addresses and interrupts of one default serial interface and XPORT3-BM.

Serial Port	QNX-name	Source	Address	IRQ	Comment
COM1	\$mdm	PC	03F8h	IRQ 4	instrument control
(COM2	<i>disabled</i>	<i>PC</i>	<i>02F8h</i>	<i>IRQ 3</i>	<i>disabled</i>)
COM2	\$term1	XPORT3	02F8h	IRQ 3	host communication
COM3	\$term2	XPORT3	02E8h	IRQ 3	barcode reader
COM4	\$term3	XPORT3	02E0h	IRQ 3	autoloader control or remote access
<div> <div>1 2 3 4 5 6</div> <div> <div></div><div></div><div></div><div></div><div></div><div></div> </div> <div>Off</div> <div> <div></div><div></div><div></div><div></div><div></div><div></div> </div> <div>On</div> </div>					

Table 2.1c: Addresses and interrupts of two default serial interfaces and XPORT3 (old edition).

Normally each serial interface is connected to a specific interrupt request line (IRQ; hardware). The internal serial interface port (COM1) usually has the port address 3F8h-3FFh and is connected to IRQ4. Using only one interrupt request line for more than one board will cause problems of communication with the ES Analyzer System. Additional serial ports should therefore have different IRQs (IRQ3 is default for COM2). If an interface board supports more than one serial I/O port, sometimes only one interrupt request line may be required (e.g. XPORT3). Refer to the instruction manual whether the board supports this.

An easy way to check if the number of serial ports and the respective interrupt request lines are correct is to use the PC hardware diagnostic program named **CHECKIT** (from TouchStone Software Corporation). The configuration and the interrupts of the serial ports within an EPSON AX2e computer (used for TWIN) are shown in **Figure 2.1a-b** and **Figure 2.2a-b**. This is the configuration as it is displayed by CHECKIT.

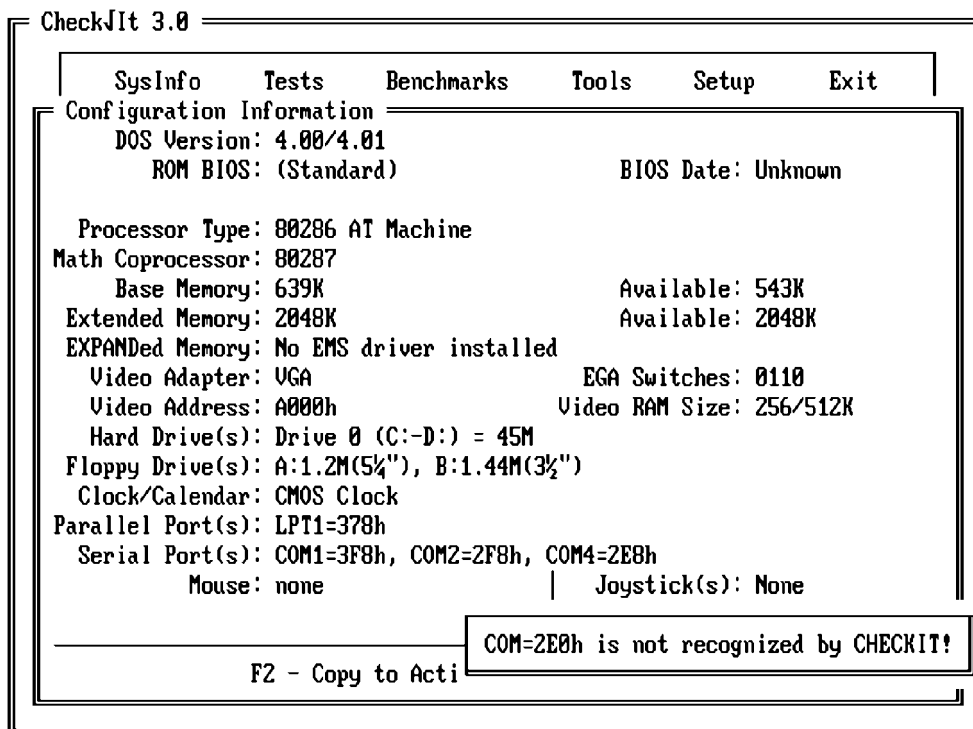


Figure 2.1a: Configuration of an EPSON AX2e for TWIN.

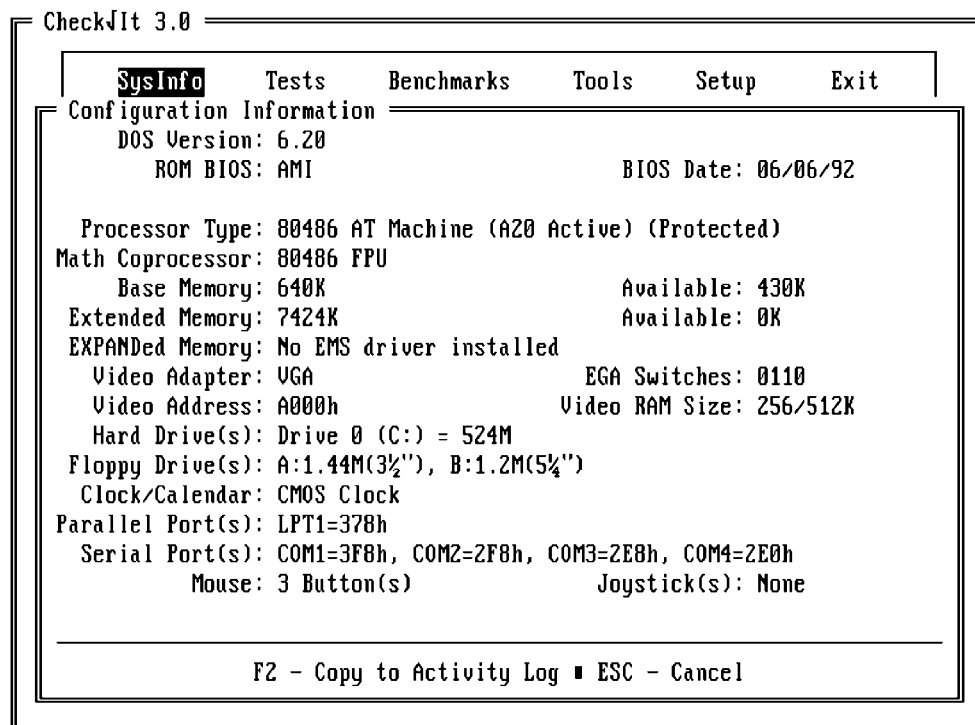


Figure 2.1b: Configuration of an 486 computer for TWIN
(Checkit is patched to recognize XPORT3).

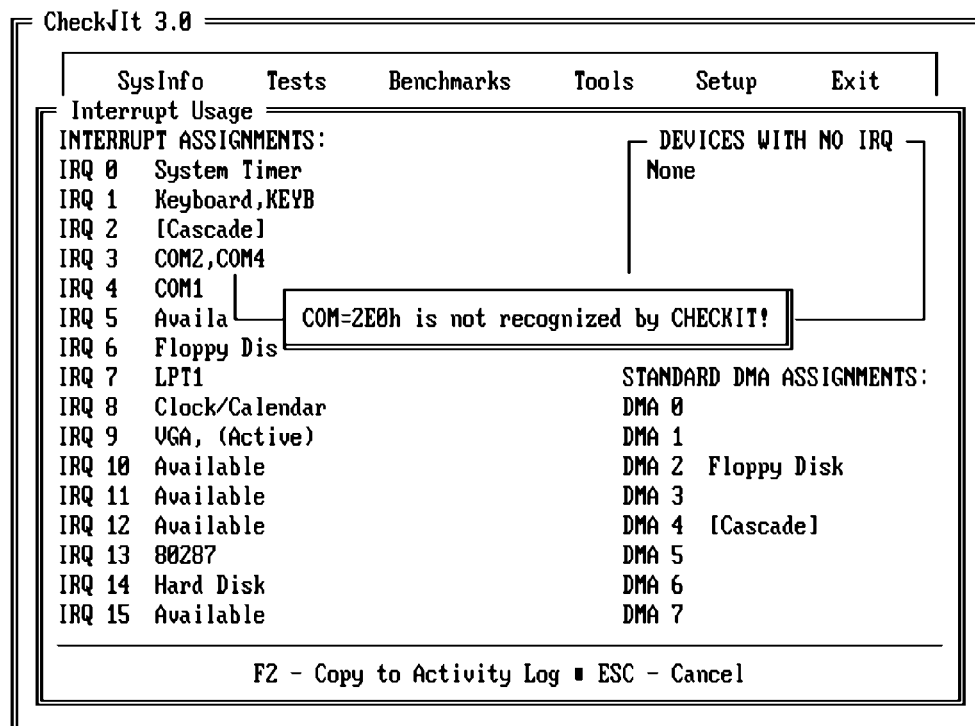


Figure 2.2a: Interrupt usage of an EPSON AX2e for TWIN.

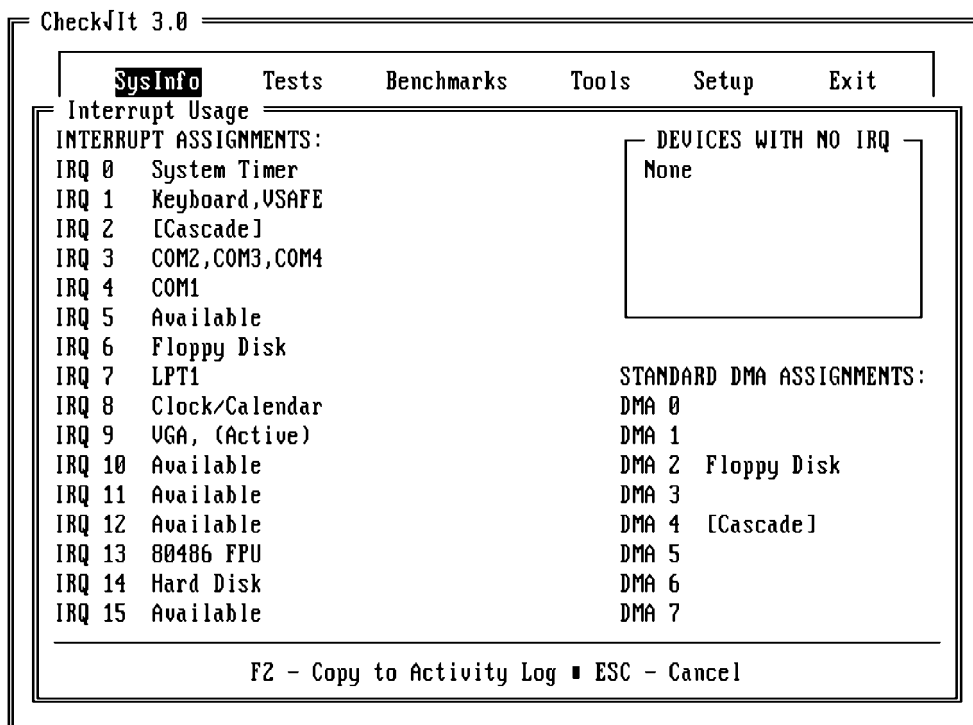


Figure 2.2b: Interrupt usage of an 486 computer for TWIN
(Checkit is patched to recognize XPORT3).

Note: DOS normally looks for the serial port addresses 3E8h, 2F8h, 3E8h and 2E8h. Therefore 2E8h of XPORT3 is indicated as COM4 and 2E0h of XPORT3 is not found. The XPORT3 needs a special driver for DOS applications. With a patch of Checkit it is possible also to recognize 2E0h. With the new XPORT-BM the standard ports (3E8h, 2F8h, 3E8h, 2E8h) will be found. Checkit is not able to recognize five ports.

ES300: The QNX operating system provides a simple command to list all recognized I/O ports of your computer. Type '*mount*' at the QNX prompt '\$' to see information like that in the screen dump below (Figure 2.3).

Thank you very much for using this system. I hope I didn't make too
much troubles for you. GOOD BYE.....

```
LOGOFF twin on [0]$tty0
  On  at Jan 22   8:50:00 am
  Off at Jan 22   8:53:00 am
----- Type a   Ctrl z   to login -----
```

```
$ mount
Drive 1: Floppy, 1.2M, p=1
Drive 2: Floppy, 1.4M, p=2
Drive 3: Hard, 41.7M, offset = 8.5k, partition= Qnx
Drive 5: RamDisk, 790k, partition= Qnx
$tty0 = $con , Colour at 0030
$tty1 = $lpt , Parallel at 0378
$tty2 = $mdm , Serial at 03F8
$tty3 = $term1 , Serial at 02F8
$tty4 = $term2 , Serial at 02E8
$tty5 = $term3 , Serial at 02E0
Library(6A): 8087 Math
Library(6E): VGA Graphics
$
```

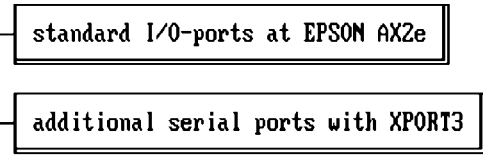


Figure 2.3a: Devices of an EPSON AX2e for TWIN listed by the QNX 'mount' command.

```
$ mount
Drive 1: Floppy, 1.2M, p=1
Drive 2: Floppy, 1.4M, p=2
Drive 3: Hard, 31.2M, offset =481.3M, partition= Qnx
Drive 5: RamDisk, 1.0M, partition= Qnx
$tty0 = $con , Colour at 0030
$tty1 = $lpt , Parallel at 0378
$tty2 = $mdm , Serial at 03F8
$tty3 = $term1 , Serial at 02F8
$tty4 = $term2 , Serial at 03E8
$tty5 = $term3 , Serial at 02E8
$tty6 = $term4 , Serial at 02E0
Library(6A): 8087 Math
Library(6E): VGA Graphics
$
```

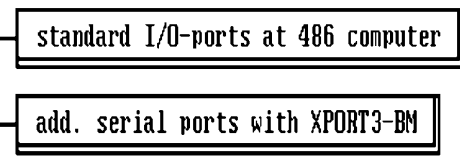


Figure 2.3b: Devices of an 486 computer for TWIN listed by the QNX 'mount' command.

2.2. Connection Cable

2.2.1. 3-Wire-Connection-Cable

The physical connection between the two systems can be established by a shielded 3-wire data cable provided with 25-pin or 9-pin SUB-D-type female connectors. The data transfer procedure specified for all **ES Analyzer Systems** uses a software handshake protocol, so that the hardware handshake signals are not required.

Subset of the default interface assignment for simple bidirectional data transfer			
	25-Pin	9-Pin	
Connection to host:			
TXD	2	3	transmit data
RXD	3	2	receive data
GND	7	5	signal ground
No connection:			
GND	1	-	protective ground
Connection on plug:			
RTS	4	7	request to send
CTS	5	8	clear to send
Connection on plug:			
DSR	6	6	data set ready
DCD	8	1	data carrier detected
DTR	20	4	data terminal ready

Table 2.2: Default interface assignment for simple bidirectional data transfer.

The TXD and RXD signals (see **Table 2.2** above) are used for the actual exchange of serial data. The remaining signals control the hardware handshake if no software protocol is used on the data lines. To ensure correct operation of the interface the hardware handshake input signals (CTS, DSR and DCD) must be held on active signal level. This is achieved by connecting the pins RTS-CTS and DSR-DCD-DTR of the connectors at **both** (!) ends of the cable. Consequently only three lines actually have to be wired (TXD, RXD and GND).

The **Tables 2.3 a-c** show how the wires have to be connected for the host interface cable using female 9-pin SUB-D-type or 25-pin SUB-D-type connectors.

SUB-D-9 female		SUB-D-9 female	
DCD 1	—	DCD 1	Data Channel Receive
RxD 2		RxD 2	Receive Data
TxD 3	—	TxD 3	Transmit Data
DTR 4	—	DTR 4	Data Terminal Ready
GND 5	—	GND 5	Signal Ground
DSR 6	—	DSR 6	Data Set Ready
RTS 7	—	RTS 7	Request to Send
CTS 8	—	CTS 8	Ready for Sending
RI 9	—	RI 9	Ring Indicator

Table 2.3 a: Pin assignment for a host communication cable with two 9-pin plugs.

SUB-D-25 female		SUB-D-25 female	
1	—	1	Protective Ground
TxD 2		TxD 2	Transmit Data
RxD 3	—	RxD 3	Receive Data
RTS 4	—	RTS 4	Request to Send
CTS 5	—	CTS 5	Ready for Sending
DSR 6	—	DSR 6	Data Set Ready
GND 7	—	GND 7	Signal Ground
DCD 8	—	DCD 8	Data Channel Received
TC 15	—	TC 15	Transmitter Signal from DCE
RC 17	—	RC 17	Receiver Signal from DCE
DTR 20	—	DTR 20	Data Terminal Ready
RI 22	—	RI 22	Ring Indicator
24	—	24	Transmitter Signal to DCE

Table 2.3 b: Pin assignment for a host communication cable with two 25-pin plugs.

SUB-D-25 female		SUB-D-9 female	
1	—	DCD 1	
TxD 2		RxD 2	
RxD 3	—	TxD 3	
RTS 4	—	DTR 4	
CTS 5	—	GND 5	
DSR 6	—	DSR 6	
GND 7	—	RTS 7	
DCD 8	—	CTS 8	
TC 15	—	RI 9	
RC 17	—		
DTR 20	—		
RI 22	—		
24	—		

Table 2.3 c: Pin assignment for a host communication cable with one 25-pin and one 9-pin plug.

2.2.2. Null-Modem-Cable

If the host computer is a personal computer the physical connection between the two systems can also be established by a so called null-modem cable with 9-wire connection.

2.3. Hardware Test

An easy way to check the interface hardware is to use the diagnostic program sometimes delivered with your computer (e.g. on the reference disk). A very useful hardware diagnostic program is **CHECKIT** (from TouchStone Software Corporation) which provides sophisticated test features for every hardware component of your personal computer. **Table 2.4** shows the pin assignment of the test adapter required for the interface tests (V.24, RS-232C).

SUB-D-25 female		SUB-D-9 female	
	1	DCD	1
TxD	2	RxD	2
RxD	3	TxD	3
RTS	4	DTR	4
CTS	5	GND	5
DSR	6	DSR	6
GND	7	RTS	7
DCD	8	CTS	8
	9	RI	9
	14		
TC	15		
	16		
RC	17		
	18		
	19		
DTR	20		
	21		
RI	22		

Table 2.4: Pin assignments of 25-pin and 9-pin test adapter plugs.

3. Computer Software Setup

3.1. Setup TWIN for ES300/600/700

3.1.1. TWIN: Setup of Communication Parameters

The following description assumes that the necessary hardware configuration is available (refer to Chapter 2.1).

If you wish to use your **ES Analyzer** and **TWIN** with your laboratory EDP or LIS (laboratory information system) you should first match the communication parameters of the ES computer with that of your host computer.

The following parameters must be set:

- port parameters (baud rate, stop bits, data bits, parity)
- transfer mode (master or slave)
- structure of data streams (request, header or measured data set)
- delay times and timeouts
- termination characters
- repetition on error
- trace file

Start TWIN as usually (see **Figure 3.1**).

LOGIN

M
A
N
N
H
E
I
M

B O E H R I N G E R

Enzymun-Test System ES300

Release X.X Date DD/MM/YY

name of the laboratory

Personal Code : Name :

LOGIN mm dd hh:mm:ss

F5=SHUTDOWN OF THE SOFTWARE (must be done before computer is switched off!)

Messages :
Sys.Status :

Figure 3.1: TWIN: Welcome screen (LOGIN).

When the second screen (**Figure 3.2**) appears select **F4 = SYSTEM PARAMETER** . A screen as shown by **Figure 3.3** appears. Select **8 = LAB COMPUTER SETUP** .

MAIN MENU

RUN QUALITY CONTROL SYSTEM PARAMETER SYSTEM FUNCTIONS

1 RECORD REQUISITIONS
2 REVIEW REQUISITIONS
3 TEST SELECTION
4 LOADING STATUS
5 RUN OPTIMISATION
6 RUN STATUS
7 DOCUMENTATION
8 DATA CONCL./ARCHIVE
9 SYSTEM CLEANING

SYM0 mm dd hh:mm:ss

F2=RUN F3=Quality Control F4=System Programming F5=System Functions

Messages :
Sys.Status :

Figure 3.2: TWIN: Main menu.

The **SETUP LAB COMMUNICATION** module is used to set up the communication parameters for bidirectional transmission between the **ES Analyzer System** and your host computer. The structures of the data sets have to be defined in addition to the communication parameters. These data sets determine the general structure of the **requested data** for **download** operations (download = transfers where requests to the **ES Analyzer System** are made from the host computer) or the general structure of the **measured data** for **upload** operations (upload = results sent from the **ES Analyzer System** to the host computer). Because of the freely selectable transfer mode - **master** or **slave** - the data transfer may be initiated (master function) from the **ES Analyzer System** or the host computer.

Note that the handling for downloading or uploading data is different for master and slave modes (refer to Chapters 3.1.2 and 3.1.3).

MAIN MENU			
RUN	QUALITY CONTROL	SYSTEM PARAMETER	SYSTEM FUNCTIONS

- 1 TEST APPLICATIONS
- 2 PROFILE DEFINITIONS
- 3 DATA COMBINATIONS
- 4 SYSTEM PARAMETER
- 5 TEST STEPS
- 6 SYSTEM STATUS
- 7 AUTHORISATION
- 8 LAB COMPUTER SETUP**

SYMO mm dd hh:mm:ss

F2=RUN F3=Quality Control F4=System Programming F5=System Functions
 Messages :
 Sys.Status :

Figure 3.3: TWIN: Main menu.

SYSTEM PARAMETER - Lab. computer setup	
Interface characteristics	Baud-rate : >300 >1200 >2400 >4800 > 9600 Data-bits : >7 > 3 Stop-bits : >1 >1.5 >2 Parity : >NO >ODD >EVEN XON/XOFF : >ON > OFF
Instrument identification	: es300
Communication with Lab. EDP	Transfer mode : > MASTER >SLAVE
Download from Lab. EDP system	: >ON >OFF
Data set	: P=RQ:03,IN:14,TC:06,RR:20;
Upload to Lab. EDP system	: >ON >OFF
Header	: P=HD:03,II:06,ON:12,DA:08;
Data set	: P=MD:07,TC:06,IN:12,TY:02,RS:10,UN:06,CC:04,ST:02;

SECO mm dd hh:mm:ss

F2=TIMEOUT F7=Print
 Messages : F9 (Upd.) or F8 (Canc.) is now possible
 Sys.Status :

Figure 3.4: TWIN: System parameter - Lab. computer setup.

In the SYSTEM PARAMETER-LAB. COMPUTER SETUP SCREEN (**Figure 3.4**) use the arrow keys to move the cursor to the appropriate line and select the desired option. The valid options are highlighted (compare to **Table 3.1**).

Type conventions:

S: Switch: Select a parameter from the parameter list.

A: Alphanumerical: Text field starting with a letter followed by letters and/or numbers. Leading spaces, commas and periods in the string are not allowed.

I: Integer: Numeric field.

Parameter	Type	Description
Baud rate:	S	Select 300 , 1200 , 2400 , 4800 or 9600
Data bits	S	Select word length of either 7 or 8 bits.
Stop bits:	S	Select 1 , 1.5 or 2 stop bits.
Parity:	S	Select no , odd or even parity.
Xon/Xoff:	S	If this is required for your host computer, you may select the XON/XOFF protocol. This is an additional software handshake which allows your host computer to interrupt the transmission until it is ready to receive new data.
Instrument identification:	A	This field included in the header record can be sent to the host allowing it to identify the analyzer which the data is coming from. See data variable II (Chapter 4.3). The maximum number of characters is 10.
Communication with Lab. EDP:	S	If set to master mode , the ES300 will initiate the communication (requesting or sending data). If set to slave mode , the host must initiate the communication. The host communication is handled differently depending on the transfer mode. Please refer to Chapters 3.1.2 and 3.1.3.

Table 3.1a: TWIN: Parameters to be set for host communication.

Parameter	Type	Description
Download from Lab. EDP system:	S	The ' on ' setting allows the ES300 system to receive test selections from the host. It is not possible to transmit requests if this parameter is set to ' off '.
Data set:	A	This character string determines the data structure of the request data being downloaded from the host. See Chapter 4.3 for details.
Upload from Lab. EDP system:	S	The ' on ' setting allows the ES300 system to send measured values to the host. It is not possible to transmit results if this parameter is set to ' off '.
Header:	A	This record of characters determines the data structure of the header data (data which is valid for the whole transmission as date, operator name or instrument identification) being uploaded to the host. See Chapter 4.3 for details.
Data set:	A	This character string determines the data structure of the result data being uploaded to the host. See Chapter 4.3 for details.

Table 3.1b: TWIN: Parameters to be set for host communication.

Use **F9 = UPDATE** or **F8 = CANCEL** to confirm or cancel the changes.

While the **SYSTEM PARAMETER - LAB. COMPUTER SETUP** screen is displayed, it is possible to access another screen and alter further system parameters. Use the softkey **F2 = TIMEOUT** to access the next screen (**Figure 3.5**).

After you have edited these parameters (see **Table 3.2**) press **F9/F8** to **UPDATE/CANCEL** them and **F10** to **EXIT** this screen.

When the screen shown in **Figure 3.4** is redisplayed, press **F10** again to return to the **main menu** (**Figure 3.2**). The communication parameters are now set for all further data transmissions.

SYSTEM PARAMETER - Setup communication

TIMEOUT LIMITS

Block length (32 - 256) : 128
Delay time at STX [x 100 ms] : 1
ACK : 1
ENQ : 1
DLE : 1
EOT : 1
Repetitions after communication error: 3
Master timeout (1 - 1200 s) : 15
Slave timeout (1 - 1200 s) : 15
Number of terminate characters (0-2) : 0
Terminate character : 0 0
TRACE : J
Number of records
for upload file (0 - 1001) : 1001

mm dd hh:mm:ss

Messages :
Sys.Status :

Figure 3.5: TWIN: System parameter - setup communication

Parameter	Type	Description
Block length:	I	The block length determines the maximum length of each data stream including control and termination characters. The block length may have any value between 32 and 256.
Delay time:	I	<p>The delay setting is the time in 100ms increments the software will wait before sending a control code. Different delay times can be set for the control codes <STX>, <ACK>, <ENQ>, <DLE> and <EOT>).</p> <p>This may sometimes be required if the host system needs time to recognize a response after having sent a stream of data.</p>
Repetition after communic. error:	I	This value specifies how many times the ES system will retry communications after a timeout error or negative acknowledgement <NAK> has occurred.

Table 3.2a: TWIN: Parameters to be set for host communication.

Parameter	Type	Description
Master timeout:	I	If set to master mode this is the amount of time in seconds the ES system will wait for a response from the host before signalling a timeout.
Slave timeout:	I	If set to slave mode this is the amount of time in seconds the ES system will wait for a response from the host before signalling a timeout.
Number of termination characters	I	This field determines the number of termination characters used for each data stream. The range is 0-2.
Termination character	I	If termination characters are used, their ASCII values must be entered here. The first field contains the value of the first and the second field contains the value of the second termination character. Example: 1. term. char.: 13 <CR> carriage return 2. term. char.: 10 <LF> line feed
Trace	S	The trace file is used for troubleshooting the communication between the ES system and the host. It is recommended to set the trace to 'on' . 'Y' indicates trace file 'on' . 'N' indicates trace file 'off' .
Number of records	I	This value specifies how many records can be uploaded to the host system at a time. The range is 0-1001. If uploading is used, the value should be set to 1001 .

Table 3.2b: TWIN: Parameters to be set for host communication.

3.1.2. TWIN: Download

To prepare downloading data, select **F2 = RUN** and **1 = RECORD REQUISITION** from the *main menu* (Figure 3.6).

Figure 3.6: TWIN: Select record requisitions

A screen as shown by Figure 3.7 will appear. Press **F7 = DOWNLOAD** to start receiving download data if the **ES Analyzer System** is operated in *master mode*. When working in *slave mode*, using this key is not permitted because the host (=master) has to initiate the communication. The download operation is then running in background.

Figure 3.7: TWIN: Start download.

3.1.3. TWIN: Upload

To prepare uploading data, select **F2 = RUN** and **7 = DOCUMENTATION** from the *main menu* (Figure 3.8).

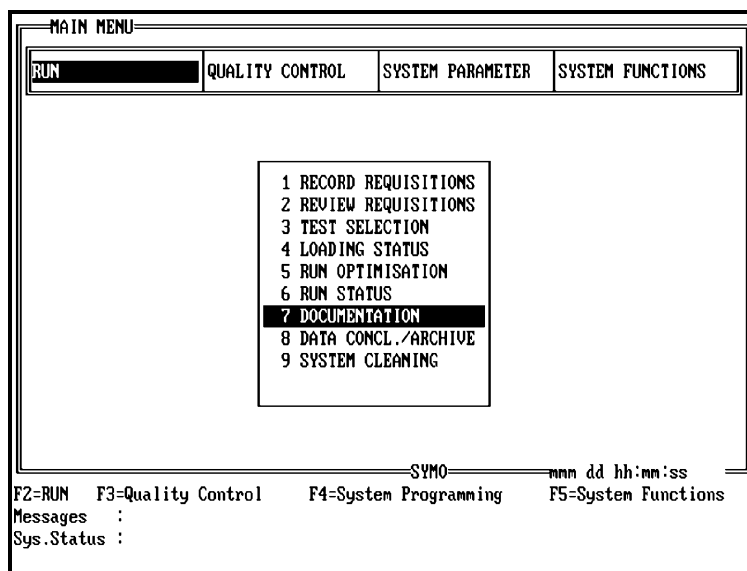


Figure 3.8: TWIN: Select documentation.

A screen as shown by Figure 3.9 will appear. Select **UPLOAD TO LAB.EDP** and the test to be transmitted, e.g. test **T4**, or press **Carriage return** to transmit all tests. The upload data (results) is stored on a file. If the analyzer is operated in *master mode*, the file content will be transmitted immediately; in *slave mode* the host has to initiate the communication.

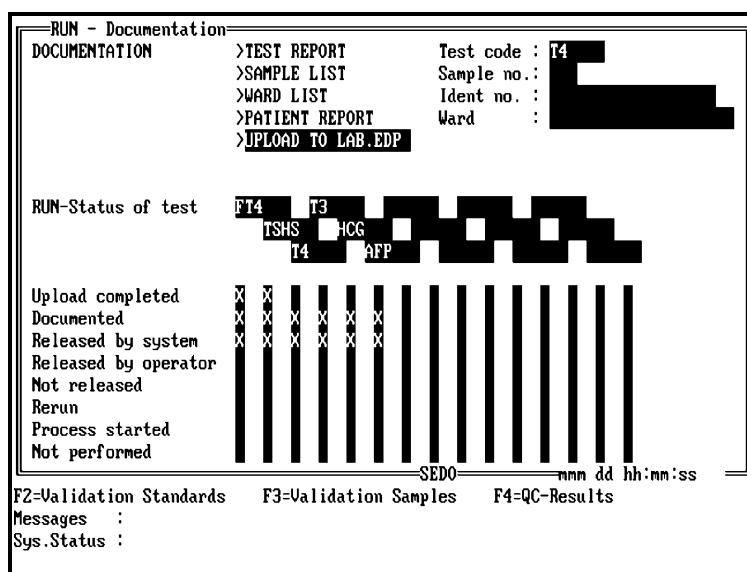


Figure 3.9: TWIN: Start upload to lab. EDP.

The results of one test can be uploaded after the whole test is performed. After the run all results depending on their system status can be uploaded (refer **Chapter 3.1.4**). They are sent test by test, each test starting with **blank value** (RL), followed by **standards** (ST) and followed by **controls** (CO) and **patent results** (PR) depending on their rotor position.

3.1.4. TWIN: System Status Assignment

The data being uploaded also depends on the current system status of the test. Select **F4 = SYSTEM PROGRAMMING** and **6 = SYSTEM STATUS** from the **main menu** (**Figure 3.10**).

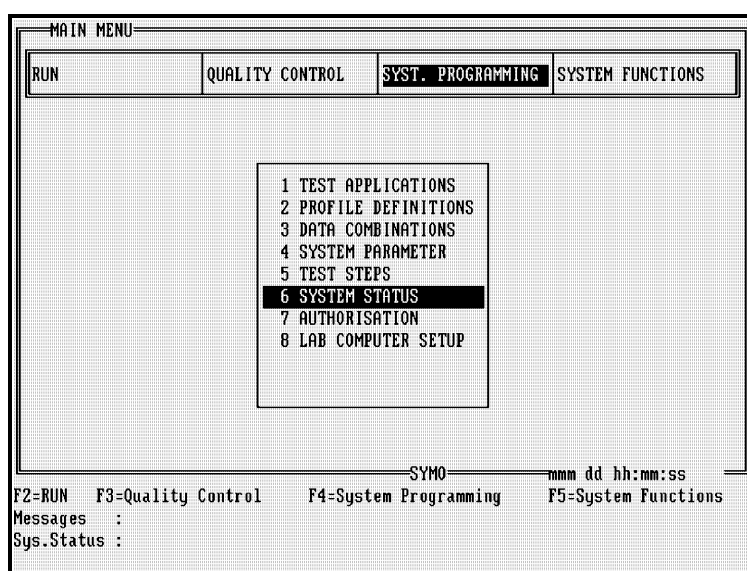


Figure 3.10: TWIN: Select system status.

Press the **PgDn**-key two times and a screen as shown in **Figure 3.11** will appear. Only status numbers **40** to **43** are valid for the **upload** (**Table 3.3**). Change the upload flags corresponding to your requirements. Changes of the upload flag **21** to **36** have no influence on the upload. **Table 3.4** is a list of all system status assignments.

status related to a	number	
test	0 - 20	not changeable
sample	21-36	changeable for rerun
released sample	40-43	changeable for upload
documented sample	50, 60	not changeable

Table 3.3: TWIN: System status assignment.

SYSTEM STATUS

Status	Description	Upload Flag	Rerun Flag	Test Report	Sample Lists
0	Undefined	-	-	W	W
1	Not yet started	-	-	W	W
2	Standards measured	-	-	I	I
3	Samples measured	-	-	I	I
4	All results measured for test	-	-	I	I
6	Test started	-	-	I	I
7	Test excluded	-	-	E	E
8	Blank replacement	-	-	W	W
10	Evaluation not possible	-	-	E	E
11	Curve released by system	-	-	I	I
12	Curve released by operator	-	-	W	W
13	Curve corrected by operator	-	-	W	W
14	Calculation with n-1 stds.	-	-	W	W
15	No monotony at standard abs.	-	-	E	E
16	Highly divergent standards	-	-	E	E
17	Check curve	-	-	E	E
18	Check curve calculation	-	-	E	E
19	Rerun of whole test	-	-	W	W
20	Not yet measured	-	-	I	I
21	Not measured	-	Y	E	E
22	Measured and o.k.	-	N	-	-
23	Absorbance out of limits (>)	-	Y	E	E
24	Absorbance out of limits (<)	-	Y	E	E
25	Calculation not possible	-	Y	E	E
26	Temperature troubles	-	N	E	E
27	Lack of washing liquid	-	N	E	E
28	Carry over (2)	-	N	E	E
29	Carry over (1)	-	N	E	E
30	Sample outside normal range	-	N	W	W
31	Sample outside conc. range	-	N	W	W
32	Bad precision of absorbances	-	N	W	W
33	Control outside target range	-	N	W	W
34	Mixer blocked	-	N	E	E
35	Evaluation not yet started	-	N	I	I
36	Tube blocked	-	N	E	E
40	Result released by operator	Y	N	W	W
41	Rerun	N	Y	W	W
42	Result blocked by operator	N	N	W	W
43	Result released	Y	N	-	-
50	Upload carried out	-	-	-	-
60	Documented	-	-	-	-

End of list

Table 3.4: TWIN: List of system status assignment.

SYSTEM PARAMETER - System status					
Status	Description	Upload Flag	Rerun Flag	Report flag Test	printout Sample
27	Lack of washing liquid	N	N	E	E
28	Carry over (2)	N	N	E	E
29	Carry over (1)	N	N	E	E
30	Sample outside normal range	N	N	W	W
31	Sample outside conc. range	N	N	W	W
32	Bad precision of absorbances	N	N	W	W
33	Control outside target range	N	N	W	W
34	Mixer blocked	N	N	E	E
35	Evaluation not yet started	N	N	I	I
36	Tube blocked	N	N	E	E
40	Result released by operator	Y	Y	W	W
41	Rerun	Y	Y	W	W
42	Result blocked by operator	N	N	W	W
43	Result released	Y	Y	-	-
50	Upload carried out	N	N	-	-
50	Documented	N	N	-	-

LESS mm dd hh:mm:ss F7=Print

Messages :
Sys.Status :

Figure 3.11: TWIN: Table with system status.

The data which will be uploaded to the host system depends only on the sample status *released* (will be uploaded) or *not released* (will not be uploaded). If a sample *not released* is set to rerun (rerun flag yes for status 21-36) and the rerun status (41) is set for upload it is also possible to upload this sample.

Since software version 1.92 the status for a 'blocked by operator' sample on host site will be 42.

Since software version 1.93 the status for a 'rerun' sample on host site will be 41.

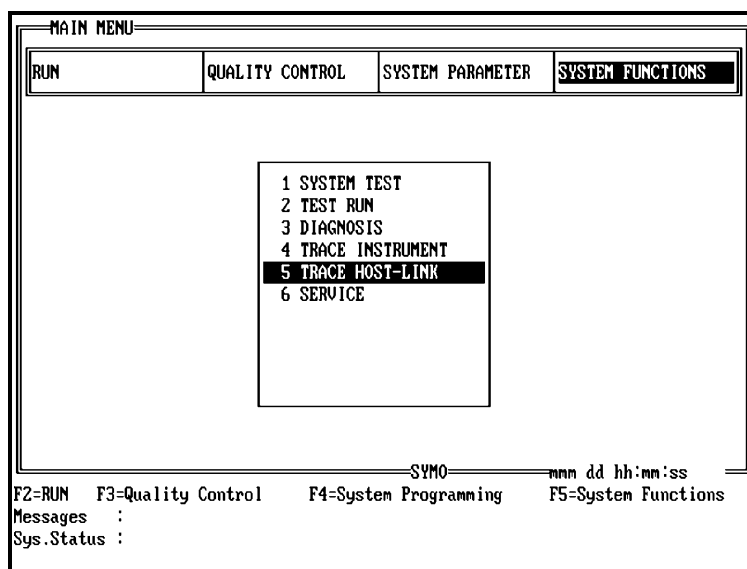
The following **Table 3.5** shows the most frequent status numbers which appear at the host system:

status	meaning	condition
22	measured and o.k.	43 must be set for upload (= default)
25	calculation not possible	if the different absorbances for the mean value calculation have different status numbers (21-24) 41 must be set to upload, 25 must be set to rerun
30	sample outside normal range	depending on released by system (43) or released by operator (40)
31	sample outside concentration range	depending on released by system (43) or released by operator (40)
41	rerun	41 must be set for upload e.g. 21 must be set for rerun
42	blocked by operator	42 must be set for upload e.g. 31 manually blocked

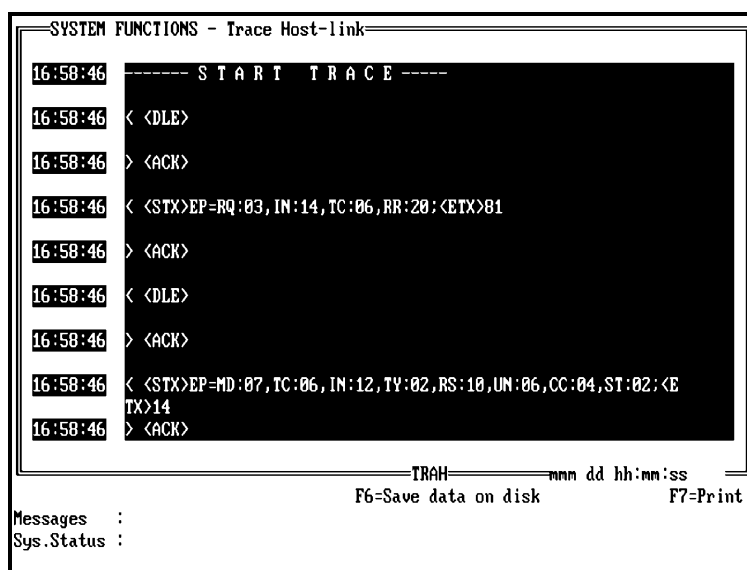
Table 3.5: TWIN: uploadable status numbers.

3.1.5. TWIN: Trace

To list the trace of the host communication, select **F5 = SYSTEM FUNCTIONS** from the main menu. When the **SYSTEM FUNCTIONS** menu (**Figure 3.12**) appears select option **5 = TRACE HOST-LINK**.

**Figure 3.12:** TWIN: Select trace of host communication.

The screen below (**Figure 3.13**) shows the host communication trace of a run. Use the softkey **F7 = PRINT** to obtain a *printout* of the trace from the current position to the end of the file. Softkey **F6 = SAVE DATA ON DISK** stores the trace from the current position to the end of the file on a diskette. The current trace file is **deleted** when a new run is started. Another possibility is to delete the host trace (*delete all HOTR*) from the undocumented option *lookingintyset*.

**Figure 3.13:** TWIN: Host communication trace

3.2. Setup MSTEP for ES33

3.2.1. MSTEP Setup of Communication Parameters

The following description presupposes that the necessary hardware configuration is available (refer to Chapter 2.1).

If you wish to use **ES33** and **MSTEP** with your laboratory EDP you should first match the communication parameters of the ES computer with those of your host computer.

The following parameters must be set:

- port parameters (baud rate, stop bits, data bits, parity)
- delay times and timeouts
- termination characters
- repetition on error
- trace file

The following parameters are **fixed**:

- transfer mode = master
- structure of data streams (request and measured data set)

Start MSTEP as usually.

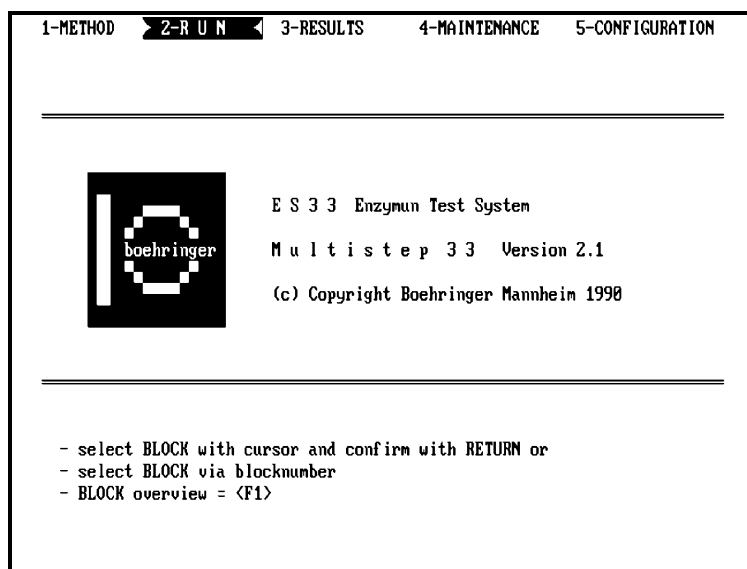


Figure 3.14: MSTEP: Welcome screen.

When the main menu screen (**Figure 3.14**) appears select **5-CONFIGURATION**. The configuration screen as shown by **Figure 3.15** appears. Select **4-HOST SETUP**.

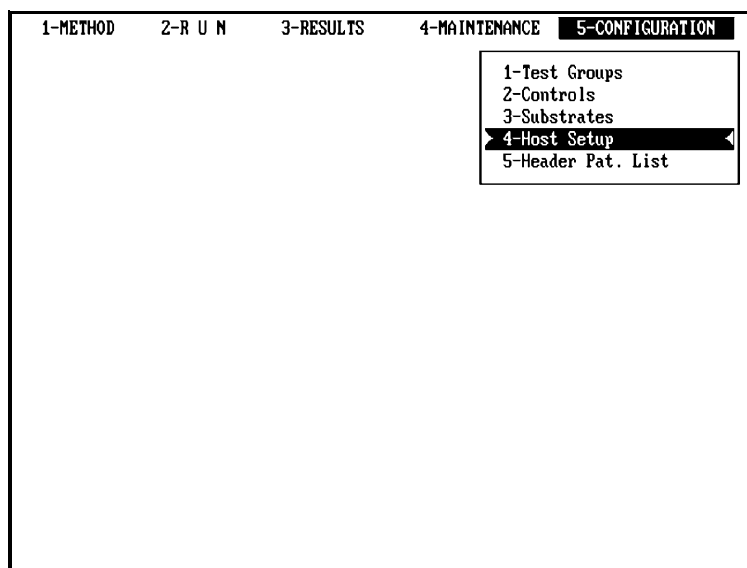


Figure 3.15: MSTEP: Configuration menu.

The **HOST SETUP** module allows to set up the communication parameters for bidirectional transmission between the **ES Analyzer System** and your host computer. The communication parameters have to be defined. In contrast to the TWIN software the structure data sets are fixed in the MSTEP software. They determine the general structure of the **requested data** for **download** operations (download = transfers where requests to the **ES Analyzer System** are made from the host computer) or the general structure of the **measured data** for **upload** operations (upload = results sent from the **ES Analyzer System** to the host computer). Here the transfer mode is **not** freely selectable. The data transfer must be initiated (master function) from the **ES Analyzer System**.

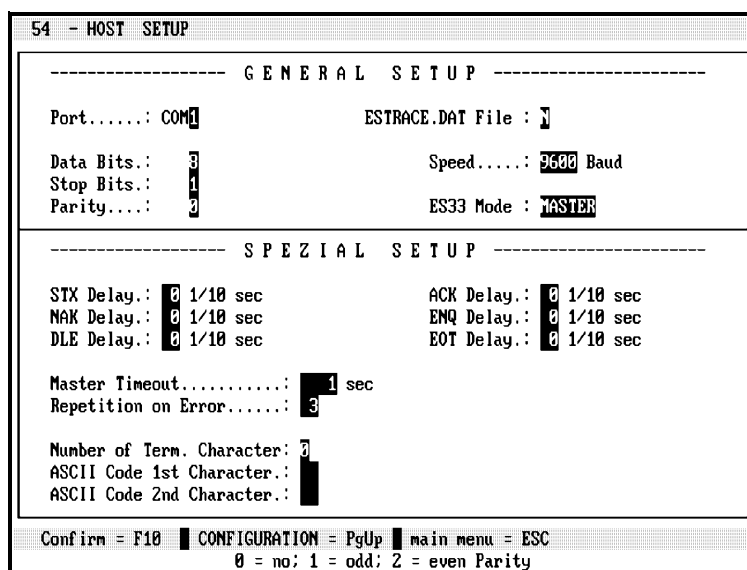


Figure 3.16: MSTEP: Host setup screen.

In the **HOST SETUP SCREEN (Figure 3.16)** use the arrow keys to move the cursor to the appropriate line and select the desired option. An information line at the bottom of the screen gives a possible choice. Also, further special system parameters may be set. The valid options are displayed (compare to **Table 3.6**).

Use **F10** to confirm or **ESC** to cancel the changes. The communication parameters are now set for all further data transmissions.

Parameter	Description
Baud rate:	Select 300 , 1200 , 2400 , 4800 or 9600
Data bits	Select word length of either 7 or 8 bits.
Stop bits:	Select 1 or 2 stop bits.
Parity:	Select no , odd or even parity.
Trace	The trace file is used for troubleshooting the communication between the ES system and the host. It is recommended to set the trace to ' on '. 'Y' indicates trace file ' on '. 'N' indicates trace file ' off '.
Delay time:	The delay setting is the time in 100ms increments the software will wait before sending a control code. Different delay times can be set for the control codes <STX>, <ACK>, <ENQ>, <DLE> and <EOT>). This may sometimes be required if the host system needs time to recognize a response after having sent a stream of data.
Repetition on error:	This value specifies how many times the ES system will retry communications after a timeout error or negative acknowledgement <NAK> has occurred.

Table 3.6a: MSTEP: Parameters to be set for host communication.

Parameter	Description
Timeout:	This is the amount of time in seconds the ES system will wait for a response from the host before signalling a timeout.
Number of termination characters	This field determines the number of termination characters used for each data stream. The range is 0-2.
Termination character	<p>If termination characters are used, their ASCII values must be entered here. The first field contains the value of the first and the second field contains the value of the second termination character.</p> <p>Example: 1. term. char.: 13 <CR> carriage return 2. term. char.: 10 <LF> line feed</p>

Table 3.7b: MSTEP: Parameters to be set for host communication.

3.2.2. MSTEP: Download

To prepare downloading data, select **2 = RUN** and **1 = RECORD REQUISITION** from the *main menu* (Figure 3.17).

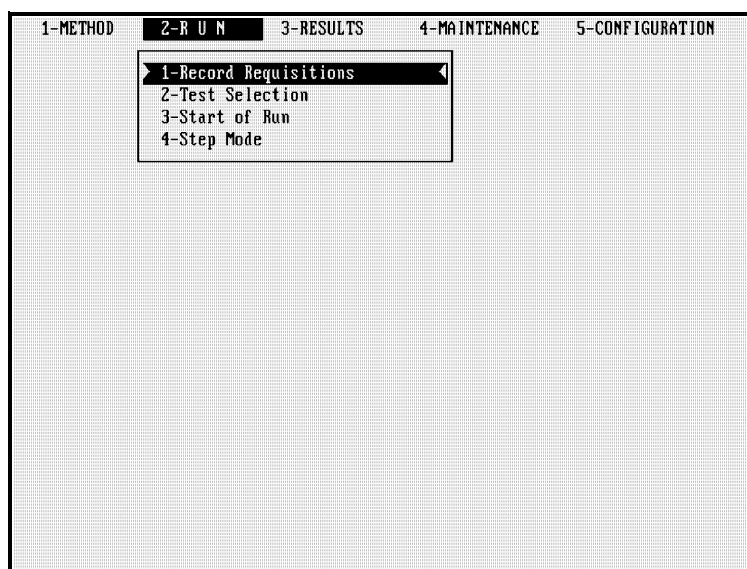


Figure 3.17: MSTEP: Select record requisitions

A screen as shown by **Figure 3.18** will appear. Press **F6 = DOWNLOAD** to start receiving download data.

Figure 3.18: MSTEP: Start download.

The messages '**Data transfer in process**' (**Figure 3.19**) and '**Data transfer finished**' will signal the start and the end of the communication. If any communication error occurs you will get the message '**Data transfer aborted**'.

Figure 3.19: MSTEP: Transfer in process.

3.2.3. MSTEP: Upload

To prepare uploading data, select **3 = RESULTS** and **4 = HOST UPLOAD** from the *main menu* (Figure 3.20).

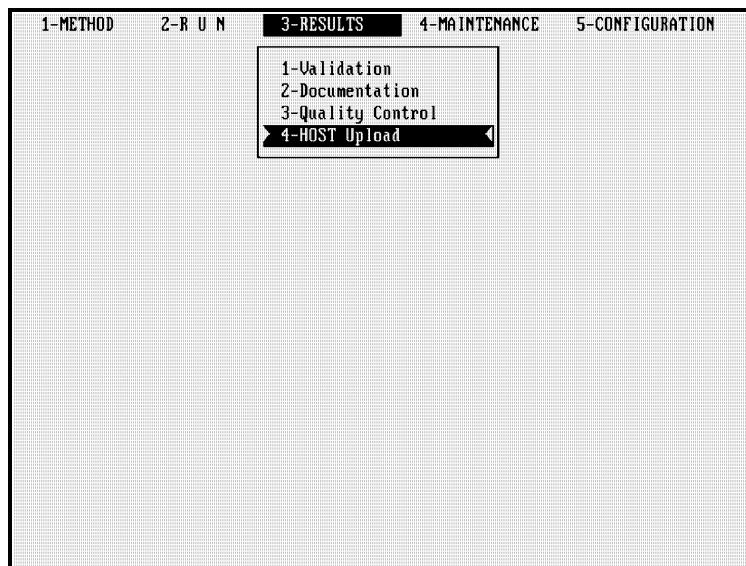


Figure 3.20: MSTEP: Select host upload.

A screen as shown by **Figure 3.21** will appear. Select the test to be transmitted, e.g. test **T3**. After confirming with the **F10**-key the upload data will be transmitted immediately.

Note: Because of a software bug in the protocol handling it is not recommended to transmit all tests at one time. Transmitting test by test, however, works perfectly.

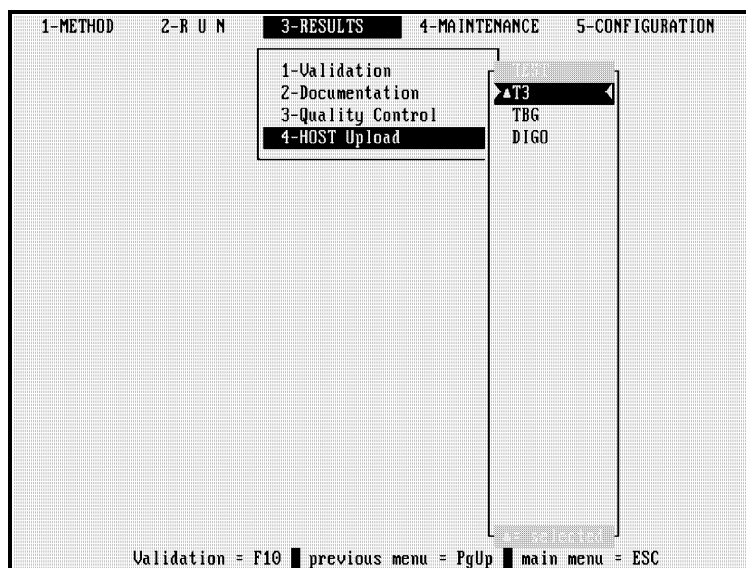


Figure 3.21: MSTEP: Start upload to lab. EDP.

If no error occurs each test can be uploaded only once. To evaluate and test the host interface program it is useful to save the files '**ESRESULT.***' which contains the measured data. It is advisable to create two batch jobs for saving and reloading the results (**Figure 3.22** and **Figure 3.23**):

```
echo off
c:
cd \mstep
copy esresult.dat esresult.ddd
copy esresult.ndx esresult.nnn
```

Figure 3.22: Batchjob to save MSTEP-results for upload (SAVEHOST.BAT).

```
echo off
c:
cd \mstep
copy esresult.ddd esresult.dat
copy esresult.nnn esresult.ndx
```

Figure 3.23: Batchjob to restore MSTEP-results for upload (LOADHOST.BAT).

The messages '**Data transfer in process**' (**Figure 3.24**) and '**Data transfer finished**' will signal the start and the end of the communication. If any communication errors occur you will get the message '**Data transfer aborted**'.

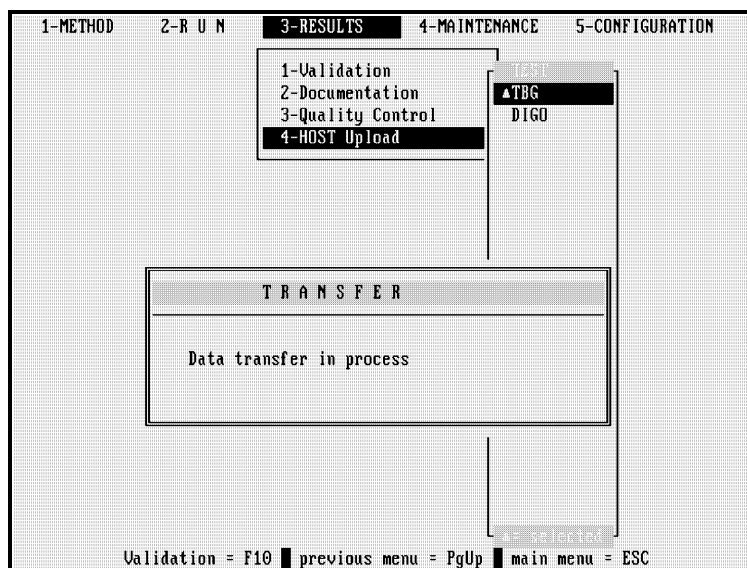


Figure 3.24: MSTEP: Transfer in process.

3.2.4. MSTEP: Trace

To print out the trace of the host communication, it is necessary to leave the MSTEP software on the DOS level. The trace file is named '**ESTRACE.DTA**' and must be sent to the printer with the DOS print command (**Figure 3.25**).

```
C:\MSTEP>print estrace.dat
```

Figure 3.25: Print out MSTEP host link trace

This file contains the trace of the **last** communication transfer.

4. Software Protocol

4.1. Code and String Structures

All data are transferred via the interfaces using **ASCII** (*American Standard Code for Information Interchange*). The codes are listed in **Table 4.1**.

Hex	Dec	ASC	Hex	Dec	ASC	Hex	Dec	ASC	Hex	Dec	ASC
00	0	<NUL>	20	32		40	64	@	60	96	`
01	1	<SOH>	21	33	!	41	65	A	61	97	a
02	2	<STX>	22	34	"	42	66	B	62	98	b
03	3	<ETX>	23	35	#	43	67	C	63	99	c
04	4	<EOT>	24	36	\$	44	68	D	64	100	d
05	5	<ENQ>	25	37	%	45	69	E	65	101	e
06	6	<ACK>	26	38	&	46	70	F	66	102	f
07	7	<BEL>	27	39	'	47	71	G	67	103	g
08	8	<BS>	28	40	(	48	72	H	68	104	h
09	9	<HT>	29	41	)	49	73	I	69	105	i
0A	10	<LF>	2A	42	*	4A	74	J	6A	106	j
0B	11	<VT>	2B	43	+	4B	75	K	6B	107	k
0C	12	<FF>	2C	44	,	4C	76	L	6C	108	l
0D	13	<CR>	2D	45	-	4D	77	M	6D	109	m
0E	14	<SO>	2E	46	.	4E	78	N	6E	110	n
0F	15	<SI>	2F	47	/	4F	79	O	6F	111	o
10	16	<DLE>	30	48	0	50	80	P	70	112	p
11	17	<XOn>	31	49	1	51	81	Q	71	113	q
12	18	<DC2>	32	50	2	52	82	R	72	114	r
13	19	<Xoff>	33	51	3	53	83	S	73	115	s
14	20	<DC4>	34	52	4	54	84	T	74	116	t
15	21	<NAK>	35	53	5	55	85	U	75	117	u
16	22	<SYN>	36	54	6	56	86	V	76	118	v
17	23	<ETB>	37	55	7	57	87	W	77	119	w
18	24	<CAN>	38	56	8	58	88	X	78	120	x
19	25		39	57	9	59	89	Y	79	121	y
1A	26	<SUB>	3A	58	:	5A	90	Z	7A	122	z
1B	27	<ESC>	3B	59	;	5B	91	[(Ä)	7B	123	{(ä)
1C	28	<FS>	3C	60	<	5C	92	\(Ö)	7C	124	|(ö)
1D	29	<GS>	3D	61	=	5D	93	] (Ü)	7D	125	} (ü)
1E	30	<RS>	3E	62	>	5E	94	^(I)	7E	126	~(ß)
1F	31	<US>	3F	63	?	5F	95	_	7F	127	<DEL>

Table 4.1: ASCII table (American Standard Code for Information Interchange)

The first 32 ASCII codes are control codes used for handling different procedures on the host and on the peripheral system. The control characters shown in **Figure 4.1** and explained in **Table 4.2a-b** are required for bidirectional data transfer between the **ES Analyzer System** and a host computer. These control codes have special meanings. Only the codes in the code range 00h to 1Fh (h=hexa decimal; 0-31 decimal) may occur during the data transfer. The ES host interface is not able to interpret the other control codes.

Elements Of Data Transmission		
<div></div>	h=hexa decimal	Information Unit = 1 byte
DLE	(10h)	Data Link Escape
ENQ	(05h)	Enquiry
STX	(02h)	Start Of Text
ETX	(03h)	End Of Text
ACK	(06h)	Acknowledge
NAK	(15h)	Negative Acknowledge
EOT	(04h)	End Of Transmission
D_i		Data Byte
E		Extension Byte ['0'...'9','E']
<div>h BCC l</div>		Block Check Code
<div>1 TC 2</div>		Termination characters

Figure 4.1: Elements of data transmission

Control char.	Hex value	Purpose																		
STX	(02h):	Start of text marks the start of the actual data record.																		
ETX	(03h):	End of text marks the end of the actual data record.																		
EOT	(04h):	End of transmission signals the end of a communication cycle.																		
ENQ	(05h):	<p>Enquiry is generally used by the master to request data from the slave system.</p> <p>The slave can respond with an acknowledgement <ACK> followed immediately by a data stream or with an end of transmission <EOT> telling the master that the slave has no data to send.</p> <p>Example:</p> <table><tr><td><i>master</i></td><td><i>slave</i></td></tr><tr><td>a. The slave has data to send:</td><td></td></tr><tr><td><ENQ> ---></td><td></td></tr><tr><td></td><td><--- <ACK></td></tr><tr><td></td><td><--- <STX>...<ETX>[BCC][TC]</td></tr><tr><td><ACK> ---></td><td></td></tr><tr><td>b. The slave has no data to send:</td><td></td></tr><tr><td><ENQ> ---></td><td></td></tr><tr><td></td><td><--- <EOT></td></tr></table>	<i>master</i>	<i>slave</i>	a. The slave has data to send:		<ENQ> --->			<--- <ACK>		<--- <STX>...<ETX>[BCC][TC]	<ACK> --->		b. The slave has no data to send:		<ENQ> --->			<--- <EOT>
<i>master</i>	<i>slave</i>																			
a. The slave has data to send:																				
<ENQ> --->																				
	<--- <ACK>																			
	<--- <STX>...<ETX>[BCC][TC]																			
<ACK> --->																				
b. The slave has no data to send:																				
<ENQ> --->																				
	<--- <EOT>																			
ACK	(06h):	The receiver acknowledges successful receipt of data string to the sender.																		
LF	(0Ah):	Line feed can be used together with <CR> as termination of a string (refer to setup termination characters, Table 3.2).																		
CR	(0Dh):	Carriage return can be used alone or together with <LF> as termination of a string (refer to setup termination characters, Table 3.2).																		

Table 4.2a: Control characters of data transmission

DLE	(10h):	<p>Data link escape is sent by the master to inform the slave system that it wants to send data.</p> <p>The slave can only respond with an acknowledgement <ACK> telling the master to go ahead.</p> <p>Example:</p> <pre> <i>master</i> <i>slave</i> <DLE> ---> <--- <ACK> </pre>
NAK	(15h):	<p>The receiving system sends <NAK> to notify the sender to repeat the last message, e.g. because of a wrong block check code.</p> <p>The ES system increments its error count. If the count exceeds the retry count as configured the ES system will cease transmission and notify the operator.</p> <p>Example:</p> <pre> <i>sender</i> <i>receiver</i> a. The receiver calculates the same BCC (=66) as received: <STX>12<ETX>66[TC] ---> <--- <ACK> b. The receiver calculates a BCC (=34) other than received (=66) because of a lost character ('2'): <STX>1<ETX>66[TC] ---> <--- <NAK> </pre>

Table 4.2b: Control characters of data transmission

The characters in the code range 20h to 7Fh (32-127 decimal) are alphanumeric and special characters from which the actual data strings are composed.

A data string is a complete unit comprising a certain number of characters and has a special length. The transmission of a data string cannot be interrupted by the receiving station and therefore requires a certain buffer capacity (e.g. 128 or 256 bytes). This restriction may require subdivision of a data string into several subsets of data strings. A leading extension byte 'E' (45h) is added to indicate the last or only subrecord of a data string. If there is more than one subrecord, the numbers between '0' and '9' (2Fh-38h) are used as extension bytes to number the records.

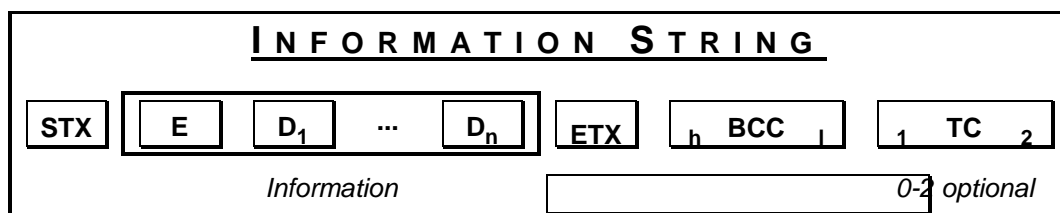


Figure 4.2a: Composition of an information string

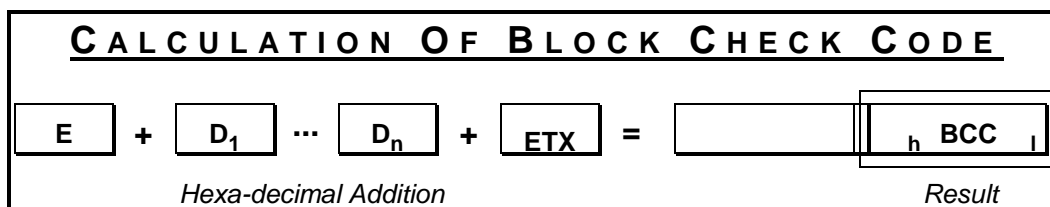


Figure 4.2b: Calculation of the block check code

Each subrecord of a data string is embedded within **<STX>** and **<ETX>** characters. A checksum (=block check code) consisting of two characters and either one or two termination characters are appended (**Figure 4.2a**). This combined information string must not be longer than the receive buffer capacity. This means that the buffer capacity for useful information sent at a time is reduced by five characters (seven characters if termination characters are used).

The block check code (BCC) is generated as the elementary sum of the **extension byte** plus **data bytes** plus **<ETX>** (refer to **Figure 4.2b**).

The result of the calculation is a 4-digit hexa decimal value. The two low-order digits of this number are converted to ASCII characters and appended to the data string. The high-order digits are not evaluated. The conversion to ASCII is required to avoid that values from the range of control codes are generated.

Example:

	<STX>	E	T	E	S	T	<ETX>			
	02h	45h	54h	45h	53h	54h	03h			
BCC=		69	+84	+69	+83	+84	+3	=392	=	0188h

Including the converted block check code, the entire string then looks as follows:

=> <STX>ETEST<ETX>88

Control codes are also provided with termination characters if these are generally used (refer to **Figure 4.3**).

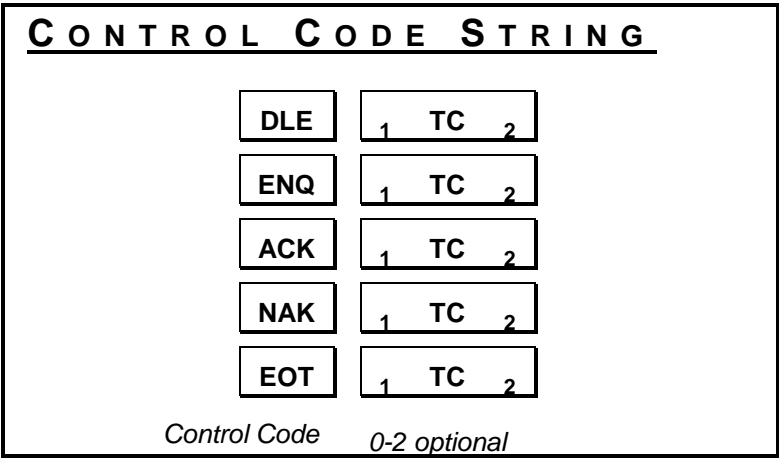


Figure 4.3: Composition of a control code string.

4.2. Protocol Structure

As mentioned in the introduction, the exchange of data between the **ES Analyzer System** and a host computer is controlled by a communication protocol with control characters being transmitted over the data lines. The communication procedure is designed for exchange of data between a master and a slave.

The master is the system initiating the requests for data transfer. Requests are always the result of an operator action. The system declared as master may send data to or request (receive) data from the slave. In accordance with this definition, the slave system must continuously be ready for reception.

Definition:

ES300: The ES300 may be configured as **master** or **slave** system (see SECO input mask of TWIN (setup Lab.EDP)). The configuration becomes immediately valid in **master mode** or after the next system start in **slave mode**. The communication port is controlled by a special task called **HOHA** (host handler). The data structures for request, header and result data can be freely defined.

ES33: The ES33 can only be configured as **master** system. The defined data structure for request and result data can not be changed. Therefore header data is not available.

4.2.1. Control Protocol for Sending Data

For the following discussion, the **ES Analyzer System** is assumed to be in master mode. If the host is master, this protocol describes the communication from the viewpoint of the host.

Figure 4.4 shows the schematic procedure for sending a data string from the **master** to the **slave**:

1. **<DLE>** (*Data Link Escape*) causes the slave system to get ready for reception (the slave is brought on-line).
2. **<ACK>** (*Acknowledgement*) signals that the slave is ready to receive data.
3. Then information is sent to the slave embedded between **<STX>** (*Start Of Text*) and **<ETX>** (*End Of Text*) followed by the **BCC** (*Block Check Code*).
4. The slave answers with **<ACK>** if the calculated BCC matches the transmitted **BCC**.
5. The master may then start a new cycle (step 1) to send a further information string.
6. If no more data is available, the master terminates the transfer by **<EOT>**.

If the system is configured that way, each stream must be sent with termination characters.

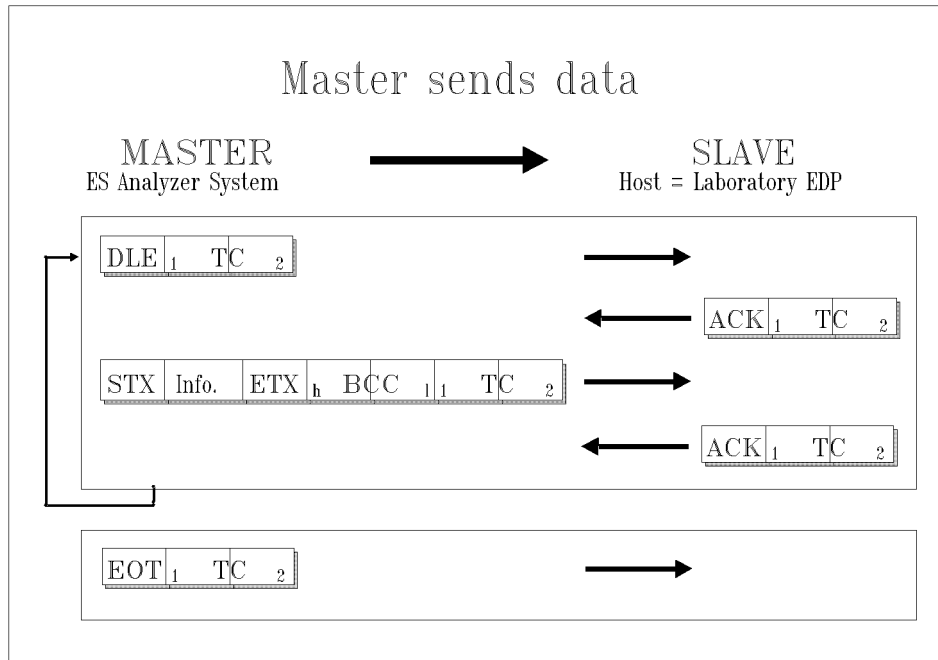


Figure 4.4: Master sends data to slave.

Table 4.3 and **Figure 4.5** below show the possible response after an information has been sent:

1. **<NAK>** (Negative Acknowledge) shows that the information is not o.k., an error was detected when checking the **BCC** (block check code). This causes the sender to repeat the last data string up to **n** times, where **n** (repetition after communication error) may be set in the TWIN software (refer to **Chapter 3.1**).
2. **Timeout:** If no acknowledgement is received after a specified time (Master/Slave Timeout), the last data string was repeated up to **n** times (see above).
3. Reception is acknowledged by **<ACK>** when the data string has proved to be correctly transmitted after checking the **BCC**.
4. In case the receiver was requested to send information and there is no more information available, the transmission is terminated. The slave is brought off-line. However, the slave interface has to remain in stand-by mode.

Master sends	Slave responds	Description
<ENQ>	<ACK> <STX>...<ETX>...	Send request from master o.k. sending next data
	<EOT>	Send request from master o.k. no more data available from slave, terminates transmission
	Timeout	No data received from master
<ACK>		Acknowledgement received from master ready to send next data stream to master
	Timeout	No acknowledgement from ma- ster received
<DLE>	<ACK>	Receive request from master o.k. ready to receive more data
	Timeout	No data received from master
<STX>...<ETX>...	<ACK>	Data stream from master o.k. ready to receive more data
	<NAK>	Data stream from master not o.k. ready to receive data again
	Timeout	No data received from master
<EOT>		End of transmission from master received

Table 4.3: Possible response to different control codes.

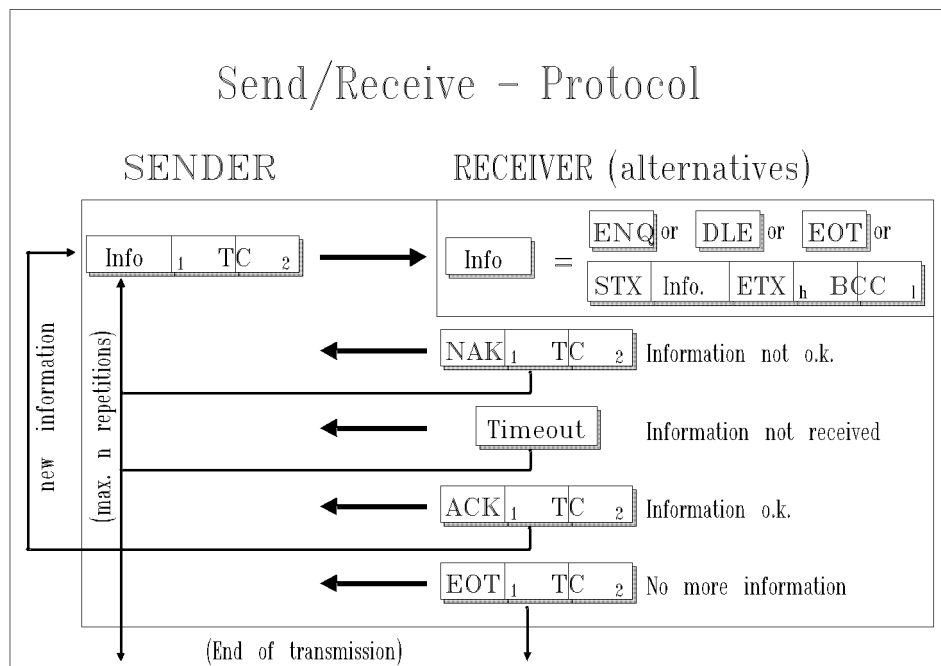


Figure 4.5: Possible response to different control codes.

4.2.2. Control Protocol for Receiving Data

Figure 4.6 shows the schematic procedure for receiving a data string from the slave (host=laboratory EDP):

1. **<ENQ>** (Enquiry) requests the slave to send data to the master and brings the slave on-line.
2. **<ACK>** (Acknowledge) signals that the slave is ready to send data.
3. Information from the slave is received.
4. The master answers with **<ACK>** if the calculated BCC matches the transmitted **BCC**.
5. The master may then start a new cycle to receive further data string, or **<EOT>** tells the master that no more data is available.

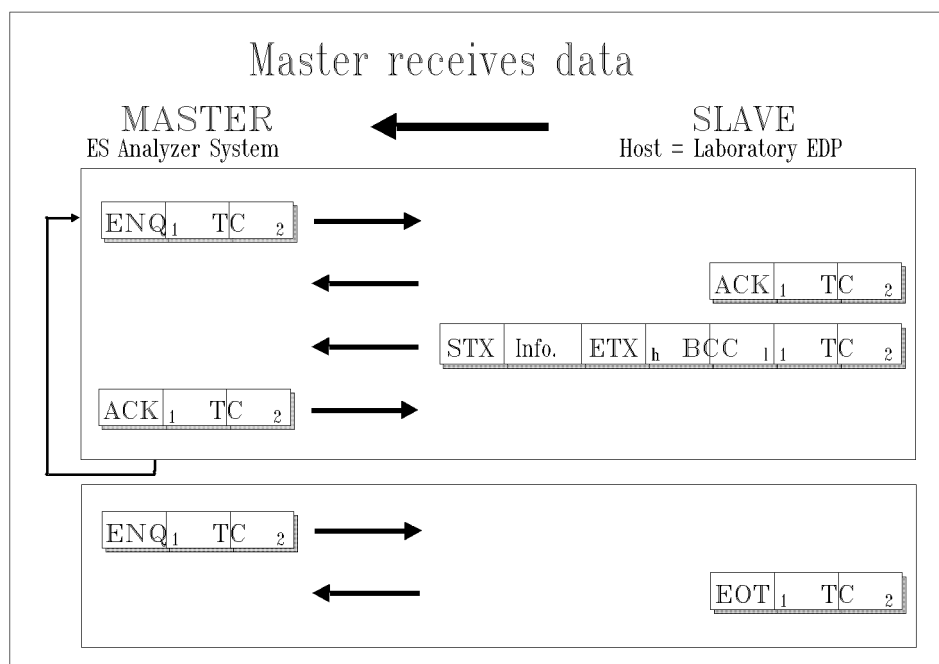


Figure 4.6: Master receives data.

4.3. Data Set Structure

The data set structure can be adapted to different demands. In this way, it satisfies different requirements of the laboratory host computer concerning the choice of parameters and the length of the data strings to be transferred. The structure can be defined by the user in the **SECO** input mask (refer to **Chapter 3.1**; **Figure 4.7**). The definition is stored on the system. All data sets are compiled in accordance with this definition prior to transfer.

The **ES Analyzer System** may optionally communicate the structure definition to the host computer system allowing it so to evaluate this information. This permits the host system to be automatically adapted to different data set structures.

The information of a data set corresponds to one test of a particular sample; e.g. several data sets with different tests may be assigned to one sample.

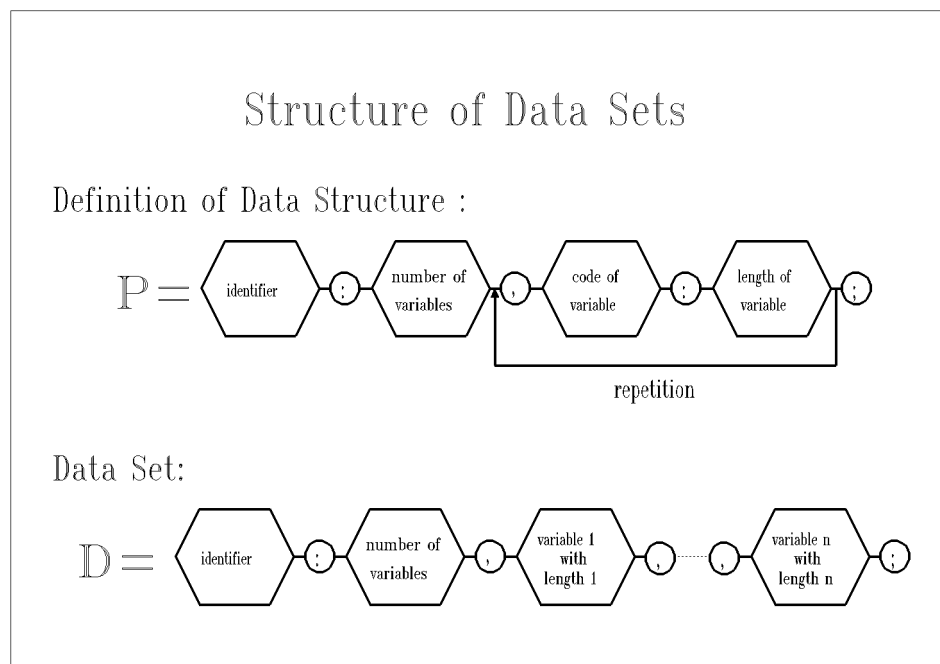


Figure 4.7: Structure of data sets

Example:**ES300:** Variable structure definition for ES300:

```
P=RQ:05,IN:14,TC:06,NA:10,VN:10,SX:02;
P=HD:03,II:10,ON:12,DA:08;
P=MD:08,IN:14,TC:06,NA:20,VN:16,TY:02,RS:06,UN:06,ST:02;
D=RQ:05,Patient.....,TSHS..,Name.....,First.Name,.1;
D=HD:03,ES300.....,Operator....,19900310;
D=MD:07,Patient.....,TSHS..,Name.....,First.Name,PR,1.23
4 ,ml/dl ,21;
```

ES33: Fixed structure definition for ES33:

```
P=RQ:02,IN:14,TC:05;
P=MD:07,IN:14,TC:05,TY:02,RS:06,UN:06,ST:02,DA:08;
D=RQ:02,Patient.....,TSHS.;
D=MD:07,Patient.....,TSHS.,PA,1.234.,ml/dl.,21,10031990;
```

The elements of this definition are:

Identifier:	<p>Type of data set. There are three types of data sets:</p> <p>RQ = Request set defining the structure of data sent by the host system (requests)</p> <p>MD = Measured value set; structure of the data set sent as result of a test to the host system.</p> <p>HD = Header set; contains information valid for all subsequent (D=MD) measured value sets (e.g. operator name, instrument identification, date).</p> <p>The identifier is terminated by a colon. A leading "P=" identifies a program set containing the information about the structure of the data set. A leading "D=" identifies a data set.</p>
Number of variables:	<p>Number of values that the data set contains. A data set may consist of 01 to 18 values. This number must match the number of subsequent variable definitions. This specification is used to additionally check the composition of values contained in a data set. It is followed by a comma and the definition of the first variable in the string.</p>
Code of variable:	<p>Code of the variable; see list of variables below. Definition of the variable code and variable length specifies the position of a value within the data set. The variable code is terminated by a colon.</p>
Length of variable:	<p>Length or number of characters of a variable. The maximum length permitted is specified in the list of variables (Table 4.4). The length of a variable may be reduced if the maximum length is not required or cannot be processed by the host system.</p>

The definition is terminated by a comma if further variables follow or by a semicolon after the last variable.

The actual data sets are transferred according to the structure definition (**Figure 4.7**).

ES Host Interface - Variables For Data Transfer									
No.	Description	Code	Direction	Type	DEC	MSTEP	TWIN	Default	Comment
1	Ident Number	IN	↕	A	14	14	20	--	no leading and no internal spaces Also spaces, commas or periods within the ident number must be avoided.
2	Test Code	TC	↕	A	6	5	6	--	no leading and no internal spaces
3	Test Number	TN	↕	I	2	--	2	--	valid range [1..99]
4	Remark Request	RR	↕	A	20	--	40	--	
5	Ward	KL	↕	A	16	--	16	HOST	
6	Patient Name	NA	↕	A	20	--	20	--	
7	First Name	VN	↕	A	16	--	16	--	
8	Sex 0 = unknown 1 = male 2 = female 3 = child	SX	↕	I	2	--	2	0	valid range [0..3]
9	Date of Birth format = YYYYMMDD or format = YYMMDD	GE	↕	A	10	--	10	--	The date can have the length 6 or 8.
10	Dilution Factor	VD	↕	I	8	--	5	1	valid range [1..99999]
11	Patient Address	PA	↕	A	-	--	60	--	
12	Instrument Identificat.	II	↑	A	6	--	10	--	
13	Operator Name	ON	↑	A	20	--	20	--	
14	Date of Run ES300: format = YYYYMMDD ES33: format = DDMMYYYY	DA	↑	A	10	8	8	--	
15	Result	RS	↑	R	8	6	8	--	numerical result; letters are not allowed
16	Alphanumerical Result	RA	↑	A	--	--	8	--	alphanumerical result; may contain letters
17	Unit	UN	↑	A	6	6	10	--	
18	Status Examples: 22 = measured and o.k. 30 = out of normal range 31 = out of conc. range	ST	↑	I	2	2	2	--	valid range [8, 20-36, 41, 42] Examples: 8 = blank replacement 41 = rerun 42 = blocked by operator
19	Type RL = reagent blank ST = standard CO = control PR = patient result (ES300) {PA = patient result (ES33)}	TY	↑	A	2	2	2	--	valid range [RL, ST, CO, PR] During upload the results will be sent test oriented following the order: 1. Blank Value 2. Standard Values 3. Samples and controles depending on rotor position
20	Remark Test Result	RT	↑	A	20	--	12	--	
21	Control Code	CC	↑	A	4	--	4	--	
22	Lot Number	IO	↑	A	12	--	12	--	
23	Mean Absorbance	AM	↑	A	6	--	8	--	depending on result labelling
24	Absorbance Value 1	AX	↑	A	6	--	8	--	depending on result labelling
25	Absorbance Value 2	AY	↑	A	6	--	8	--	depending on result labelling
26	Absorbance Value 3	AZ	↑	A	6	--	8	--	depending on result labelling
27	Sample Rotor Position	AI	↑	I	3	--	3	--	valid range [1-150]

Table 4.4a: Variables for data transfer

ES Host Interface - Variables For Data Transfer									
No.	Description	Code	Direction	Type	DEC	MSTEP	TWIN	Default	Comment
Compatibility to older ES User Software Versions									
28	Numerical Result (compatible to DEC Software field RS)	R1	↑	R	--	--	8	--	numerical result; letters are not allowed
29	Alphanumeric Result (compatible to TWIN 1.13 field RS)	R2	↑	A	--	--	8	--	alphanumeric result; may contain letters
30	Mean Absorbance (compatible to DEC)	A0	↑	R	--	--	8	--	corresponds to AM; numerical value only
31	Absorbance Value 1 (compatible to DEC)	A1	↑	R	--	--	8	--	corresponds to AX; numerical value only
32	Absorbance Value 2 (compatible to DEC)	A2	↑	R	--	--	8	--	corresponds to AY; numerical value only
33	Absorbance Value 3 (compatible to DEC)	A3	↑	R	--	--	8	--	corresponds to AZ; numerical value only
34	Prevalue 1	PV	↓↑	R	8.3	--	--	--	Due to history only dummy variables; will not be used internally; requests (from host) will be ignored; results (to host) will be sent as empty field
35	Prevalue 2	PX	↓↑	R	8.3	--	--	--	
36	Prevalue 3	PY	↓↑	R	8.3	--	--	--	

Table 4.4b: Variables for data transfer**Declarations:**

- ↓ Download (requestion data: host → analyzer)
- ↑ Upload (measure data: analyzer → host)
- ⇅ Upload (header data: analyzer → host)
- A** alphanumeric field:
 Not allowed are separators like ‘,’ (comma) and ‘;’ (semicolon). Else all printable characters of the ASCII table can be used.
 No leading spaces within key fields, like IN and TC.
 Also spaces, commas or periods within the ident number or the test code must be avoided.
 Alphanumerical fields (A) will be written as read.
- N** numerical field:
 Valid characters are 0..9, the decimal point ‘.’, space and ‘+’ and ‘-’ for positive and negative results.
 If the result is invalid it will be sent as an empty field.
 Reading spaces within a numerical field results in a default value (e.g. VD=1 or SX=0).
 Numerical fields have not be right justified or left justified.
 Leading spaces or zeros will be cutted. Numerical values will be written left justified.
- D** date field:

Format is YYYYMMDD or YYMMDD.

Date fields will be read and written left justified (fixed length 6 or 8).

Different result field types:

- RS, R1** The numerical result fields RS and R1 are only of the character range [0..9, '.', '+', '-']. Cutoff-results will have '+1' for 'pos'='>', '-1' for 'neg'='<' and '0' for 'border'='='. Results out of concentration range, where a result label '>', '<' or '*****' should appear the field will be sent as an empty field.
- RA, R2** The result fields RA and R2 are alphanumerical. The result value will be constructed out of the regular measured value following the so called printflag '>', '<' for values out of concentration range or ' ' (space) for valid results. Depending on the input to the 'result marks' within the menu test applications cutoff values will be sent as 'pos' for '>', 'neg' for '<' and ' ' for '=' (border).

Labelling of results for upload:

- | | | |
|--------|--------------|--|
| > / < | (RA, AM) | The calculated value is above/below the highest/lowest standard, or outside the upper/lower extrapolation range. The noted result is the concentration of the highest/lowest standard or the upper/lower extrapolation limit. The host must check status (31). |
| ***** | (RA, AM) | The concentration value is below zero. The host must check status. |
| <<<<<< | (AX, AY, AZ) | The measured absorbance was lower than -1. The host must check status. |
| >>>>>> | (AX, AY, AZ) | The measured absorbance is higher than the maximum absorbance defined in the test applications. The host must check status. |
| ----- | (AX, AY, AZ) | The absorbance has not been measured. No valid concentration value has been determined. The host must check status. |

Different contents of result fields:

	DEC Softw. compatible	TWIN 1.13 compatible	TWIN 1.3 & 1.2 Update 'new' definition		Remark
	R1 A0, A1, A2, A3	R2 AM, AX, AY, AZ	RS AM, AX, AY, AZ	RA AM, AX, AY, AZ	Rn: result An: absorbance
	numerical	alpha-num.	numerical	alpha-num.	
Cutoff:	'+1....'	'POS...'	'+1....'	'·POS...'	Rn only
	'0.....'	'GREY...'	'0.....'	'·GREY...'	
	'-1....'	'NEG...'	'-1....'	'·NEG...'	
empty field:	'-99999'	'.....'	'.....'	'.....'	
invalid values*:	'-99999'	'.....'	'.....'	'.....'	
zero values:	'0.00...'	'0.00...'	'0.00...'	'·0.00...'	
normal range value:	'1.23...'	'1.23...'	'1.23...'	'·1.23...'	
	'100000'	'100000'	'100000'	'.....'	
value < 0:	'-99999'	'*****'	'.....'	'*****'	
value < lower standard:	'0.10...'	'0.10...'	'.....'	'<0.10...'	
value > upper standard:	'2.00...'	'2.00...'	'.....'	'>2.00...'	
'.....' = does not fit field length => use greater length					

Table 4.5: Different contents of result fields

Short Fields:

In the case that the result field length is not long enough to hold the measured value the '**invalid value**' will be used.

Result	RS:06	RA:06 1. character print flag	RS:08	RA:08 1. character print flag
123.45	'123.45'	'.....'	'123.45...'	'·123.45...'
NEGATIV	'-1....'	'.....'	'-1.....'	'·NEGATIV'

Default Values:

Differences for the default values (**invalid value** and **empty field**):

R1: Default value for uncalculated results: '-99999'.

R2: Default value for uncalculated results: '.....'.

RS: Default value for uncalculated results: '.....'.

RA: Default value for uncalculated results: '.....'.

[A0, A1, A2, A3]: Default value for uncalculated results: '-99999'.

[AM, AX, AY, AZ]: Default value for uncalculated results: '.....'.

History of changes:**TWIN300 Release 1.13:**

The result field RS within TWIN300 version 1.13 was a mixture of numerical and alphanumerical results (incompatible with the DEC User Software for ES600).

TWIN300 Release 1.3:

With TWIN300 version 1.3 the result field RS was consequently changed into an alphanumerical field. The numerical value was added by the so called print flag which marks results out of normal range ('>' and '<' -marks).

Host-Update for TWIN300 Release 1.3 and TWIN600/700 Release 1.2:

Problems now with existing ES600 host connections resulted in a host communication update. The result field RS was renamed into RA (alphanumerical result) and the 'new' field RS (numerical result) was created with pure numerical values. Additionally, to avoid checking status flags on the host side it was agreed on that only valid results will be sent to the host. Otherwise the result field will be empty.

- ♦ *TWIN300/600/700 Update 1.6..1.92:*

The practical experience with different realisations of host communication on host side showed the differences and incompatibility between the existing host communication versions. The introduction of some more parameters and some other add ons now make a link to older ES-software versions.

- ♦ *TWIN300/600/700 Update 1.93:*

The status for rerun (41) will be sent to the host for samples with this flag.

- ♦ *Differences between TWIN and DEC User Software:*

The DEC user software allows spaces within ident numbers or tests.

Separator within a data set: TWIN reads up to a comma. DEC reads up to a comma and checks the position.

Conversion Table For Result Abbreviations:

If there is an existing conversion table ('**DCOM.PARA**') it is possible to transfer another parameter than it is defined in the data structure set. '**DCOM.PARA**' does not exist by default!

Example:

TWIN 1.92 uses R1 for DEC compatible results. A host, however, may expect the structure definition RS. Create the file **DCOM.PARA** with the conversion table and put '–' to the position RS and 'Rs' to the position R1.

The default file 'DCOM.DEC' gives an example. Copy the file 'DCOM.DEC' into 'DCOM.PARA'.

```
cd /user/twin
cp DCOM.DEC DCOM.PARA
ed DCOM.PARA
```


5. Examples

5.1. Definitions

Master: Communication partner initiating the data transmission.

Slave: Waits until the master tells him what to do.

Download: Transmission from the host computer to the **ES Analyzer System** (requested data sets).

Upload: Transmission from the **ES Analyzer System** to the host computer (measured data sets).

'>' Incoming data from ES system to test program.

'<' Outgoing data from test program to ES system.

'+' Additional print line because of line overflow

The traces were produced using the ES Host Interface test program.

5.2. ES300

5.2.1. ES300 Operated in Master Mode

5.2.1.1. ES300: Master Mode - Download Trace

Host-Interface- Test..Version.1.0.....03/03/1991 Slave.....»--»Download.»-- >.....Master local.system..(Host.)...(COM1:9600,n,8,1,- ,0)..remote.system.(ES300) ----- ----- 11:21:22:.....Transmission.started.---	This is a trace of the host interface test program.
11:21:32.>.<<DLE> 11:21:32.<.<ACK> 11:21:32.>.<<STX>EP=RQ:03,IN:14,TC:06,RR:20;<ETX>81 11:21:33.<.<ACK>	The ES Analyzer System starts the transfer as master with a send request (data link escape). The host responds by o.k. (acknowledge) for being ready. The ES system sends the first structure data set (request data). The host responds by o.k. (acknowledge) for having understood.
11:21:34.>.<<DLE> 11:21:34.<.<ACK> 11:21:34.>.<<STX>EP=MD:06,IN:14,TC:06,RS:06,ST:02,RR:20,TY:02; .....+<ETX>C7 11:21:36.<.<ACK>	The ES system requests a new send data set. The host responds by o.k. (acknowledge) for being ready so that the ES system can send the next structure data set.
11:21:36.>.<<DLE> 11:21:36.<.<ACK> 11:21:36.>.<<STX>EP=HD:03,II:10,ON:10,DA:08;<ETX>49 11:21:37.<.<ACK>	Third structure data set.
11:21:37.>.<<ENQ> 11:21:37.<.<ACK> 11:21:37.<.<STX>ED=RQ:03,Identnumber001,T4....,Remark-Request- .....+---001;<ETX>6E 11:21:39.>.<<ACK>	The ES system now initiates the transfer of a receive request (enquiry). The host responds by o.k. (acknowledge) and sends the first or next request data set directly. The ES system responds by o.k. (acknowledge) for having understood
11:21:39.>.<<ENQ> 11:21:39.<.<ACK> 11:21:39.<.<STX>ED=RQ:03,Identnumber001,TSH....,..... ..... .....+.....;<ETX>B6 11:21:42.>.<<ACK>	and asks for the next receive request. This procedure is repeated until all request data sets are sent from host to ES system.

11:21:42.>.<ENQ> 11:21:42.<.<ACK> 11:21:42.<.<STX>ED=RQ:03,Identnumber002,T4....,Remark- Request- .....+---003;<ETX>71 11:21:44.>.<ACK>	... etc. ...
..
11:22:05.>.<ENQ> 11:22:05.<.<ACK> 11:22:05.<.<STX>ED=RQ:03,Identnumber002,TSH....,..... ..... .....+.....;<ETX>B9 11:22:06.>.<ACK>	... etc. ...
11:22:09.>.<ENQ> 11:22:09.<.<EOT>	until the host sends an end of transmission indicating that there are no more requests.
11:22:09.....Transmission.finished.....	

5.2.1.2. ES300: Master Mode - Upload Trace

Host-Interface- Test..Version.1.0.....03/03/1991 Slave.....<--«..Upload..«-- «.....Master. local.system..(Host.)...(COM1:9600,n,8,1,- ,0)..remote.system.(ES300). ----- ----- 20:36:50.....Transmission.started.---	This is a trace of the host inter- face test program.
20:37:08.>.<DLE> 20:37:08.<.<ACK> 20:37:08.>.<STX>EP=RQ:09,IN:14,TC:06,RR:16,NA:14,VN:10,GE :08,S .....+X:02,KL:14,VD:03;<ETX>E3 20:37:08.<.<ACK>	The ES Analyzer System starts the transfer as master with a send request (data link escape). The host responds by o.k. (acknowledge) for being ready. The ES system sends the first structure data set (request data). The host responds by o.k. (acknowledge) for having un- derstood.
20:37:08.>.<DLE> 20:37:08.<.<ACK> 20:37:08.>.<STX>EP=MD:18,TY:02,ST:02,IN:14,TC:06,RS:06,RR :20,N .....+A:16,VN:12,GE:10,KL:14,VD:03,UN:08,RT:16,AM:06 ,AX:0 .....+6,AY:06,AZ:06,AI:05;<ETX>70 20:37:09.<.<ACK>	The ES system requests a new send data set. The host responds by o.k. (acknowledge) for being ready so that the ES system can send the next structure data set.

20:37:09.>.<<DLE> 20:37:09.<.<ACK> 20:37:09.>.<<STX>EP=HD:03,II:10,ON:10,DA:08;<ETX>49 20:37:09.<.<ACK>	Third structure data set.
20:37:09.>.<<DLE> 20:37:09.<.<ACK> 20:37:09.>.<<STX>ED=HD:03,ES300.....,Centner...,19910303;<ETX>4 .....+3 20:37:09.<.<ACK>	Using the same kind of protocol the first result data set (=header data set) with global information is now transferred from the ES system to the host.
20:37:09.>.<<DLE> 20:37:09.<.<ACK> 20:37:09.>.<<STX>ED=MD:18,RL,0.,.....,DIGO.,.... ..,+.....,....., ..,+.....,.....,....,NMOL/L., .....+....,....1,....1,.....,.....;<ETX>50 20:37:10.<.<ACK>	The upload data is sent test by test. Each test starts with a blank value (RL=Reagent Blank).
20:37:10.>.<<DLE> 20:37:10.<.<ACK> 20:37:10.>.<<STX>ED=MD:18,ST,32,.....,DIGO.,3.00 ..,+.....,....., ..,+.....,.....,....,NMOL/L.,..TOXIC .....+....,0.002.,0.003.,0.000.,.....,146..;<ETX>82 20:37:11.<.<ACK>	After the blank value all standard values (ST) are sent. First standard.
..
20:37:13.>.<<DLE> 20:37:13.<.<ACK> 20:37:13.>.<<STX>ED=MD:18,ST,32,.....,DIGO.,3.00 ..,+.....,....., ..,+.....,.....,....,NMOL/L.,..TOXIC .....+....,0.002.,0.003.,0.001.,.....,150..;<ETX>7E 20:37:14.<.<ACK>	Last standard.
20:37:14.>.<<DLE> 20:37:14.<.<ACK> 20:37:14.>.<<STX>ED=MD:18,PR,30,Patient-Id-001,DIGO.,3.00.,Re .....+mark-Request-1....,Patient-Name-1.,First-Name-1,19 .....+901011.,Ward/Station-1,1.,NMOL/L.,..TOXIC .....+....,0.002.,0.002.,.....,.....,1....;<ETX>1E 20:37:15.<.<ACK>	After the standard values the patient results (PR) are sent.
..	After the last patient result for this test the next test will be sent starting with the blank result. ..

20:37:17.>.<DLE> 20:37:18.<.<ACK> 20:37:18.>.<STX>ED=MD:18,PR,31,Patient-Id- 005,CORT.,60.00.,Re .....+mark-Request-5.....,Patient-Name-5.,First- Name-5,19 .....+901019.,Ward/Station-5,1.,nmol/l.,..... .....+.,0.001.,0.001.,.....,.....,143.;<ETX>3E 20:37:18.<.<ACK>	Last patient result for the last test.
20:37:18.>.<EOT>	
23:37:18.....Transmission.finished.....	

5.2.2. ES300 Operated in Slave Mode

5.2.2.1. ES300: Slave Mode - Download Trace (First Option)

Host-Interface- Test..Version..1.0.....03/03/1991 Master.....»--»..Download.»-- >.....Slave.. local.system..(Host..)....(COM1:9600,n,8,1,- ,0).. <remote.system..(es300) </remote.system..(es300) ----- ----- 11:21:22:.....Transmission.started.---	This is the trace of the host interface test program.
11:21:32.<.<ENQ> 11:21:32.>.<ACK> 11:21:32.>.<STX>EP=RQ:03,IN:14,TC:06,RR:20;<ETX>81 11:21:33.<.<ACK>	<p>The host starts the transfer as master with a receive request (data link escape).</p> <p>The ES system sends o.k. (acknowledge) for having understood and sends the first structure data set.</p> <p>The host responds by o.k. (acknowledge) for having understood</p>
11:21:34.<.<ENQ> 11:21:34.>.<ACK> 11:21:34.>.<STX>EP=MD:06,IN:14,TC:06,RS:06,ST:02,RR:20,TY:02; .....+<ETX>C7 11:21:36.<.<ACK>	<p>and requests a new receive data set.</p> <p>The ES system answers o.k. (acknowledge) for being ready and sends the next structure data set.</p>
11:21:36.<.<ENQ> 11:21:36.>.<ACK> 11:21:36.>.<STX>EP=HD:03,II:10,ON:10,DA:08;<ETX>49 11:21:37.<.<ACK>	Third structure data set.
11:21:37.<.<DLE> 11:21:37.>.<ACK> 11:21:37.<.<STX>ED=RQ:03,Identnumber001,T4.....,Remark-Request- .....+--001;<ETX>6E 11:21:39.>.<ACK>	<p>The host now initiates the transfer of send requests (data link escape).</p> <p>The ES system answers o.k. (acknowledge) for being ready.</p> <p>The host sends the first or next request data set.</p> <p>The ES system answers o.k. (acknowledge) for having understood</p>
11:21:39.<.<DLE> 11:21:39.>.<ACK> 11:21:39.<.<STX>ED=RQ:03,Identnumber001,TSH.....,Remark-Request- .....+--002;<ETX>B6 11:21:42.>.<ACK>	<p>The host asks for the next send request.</p> <p>This procedure is repeated until all request data sets are sent from host to ES system.</p>
11:21:42.<.<DLE> 11:21:42.>.<ACK> 11:21:42.<.<STX>ED=RQ:03,Identnumber002,T4.....,Remark-Request- .....+--003;<ETX>71 11:21:44.>.<ACK>	... etc. ...

..	..
..	..
..	..
11:23:34.<.<DLE> 11:23:34.>.<ACK> 11:23:34.<.<STX>ED=RQ:03,Identnumber002,TSH... ,Remark-Request- .....+---004;<ETX>B9 11:23:37.>.<ACK>	... etc. ...
11:23:37.<.<EOT>	until the host sends an end of transmission indicating that there are no more requests.
11:23:38.....Transmission.finished.---	

5.2.2.2. ES300: Slave Mode - Download Trace (Second Option)

Host-Interface- Test..Version.1.0.....03/03/1991 Master.....»--»Download.»-- >.....Slave.. local.system..(Host..)....(COM1:9600,n,8,1,- ,0)..remote.system.(ES300) ----- ----- 11:21:22.....Transmission.started.---	This is the trace of the host interface test program.
11:21:37.<.<DLE> 11:21:37.>.<ACK> 11:21:37.<.<STX>ED=RQ:03,Identnumber001,T4... ,Remark-Request- .....+---001;<ETX>6E 11:21:39.>.<ACK>	The host initiates the transfer of send requests (data link escape) directly without receiving the structure information. The ES system answers o.k. (acknowledge) for being ready. The host sends the first or next request data set. The ES system answers o.k. (acknowledge) for having understood.
11:21:39.<.<DLE> 11:21:39.>.<ACK> 11:21:39.<.<STX>ED=RQ:03,Identnumber001,TSH... ,Remark-Request- .....+---002;<ETX>B6 11:21:42.>.<ACK>	The host asks for the next send request. This procedure is repeated until all request data sets are sent from host to ES system.
11:21:42.<.<DLE> 11:21:42.>.<ACK> 11:21:42.<.<STX>ED=RQ:03,Identnumber002,T4... ,Remark-Request- .....+---003;<ETX>71 11:21:44.>.<ACK>	... etc. ...
..	..
..	..
..	..

11:23:34.<.<DLE> 11:23:34.>.<ACK> 11:23:34.<.<STX>ED=RQ:03,Identnumber002,TSH...,Remark-Request- .....+--004;<ETX>B9 11:23:37.>.<ACK>	... etc. ...
11:23:37.<.<EOT>	until the host sends an end of transmission indicating that there are no more requests.
11:23:38.....Transmission.finished.----	

5.2.2.3. ES300: Slave Mode - Upload Trace

Host-Interface- Test..Version.1.0.....03/03/1991 Master.....<--«..Upload..«-- «.....Slave.. local.system..(Host.)...(COM1:9600,n,8,1,- ,0)..remote.system.(ES300). ----- ----- 17:56:50.....Transmission.started.---	This is a trace of the host interface test program.
17:57:08.<.<ENQ> 17:57:08.>.<ACK> 17:57:08.>.<STX>EP=RQ:09,IN:14,TC:06,RR:16,NA:14,VN:10,GE:08,S .....+X:02,KL:14,VD:03;<ETX>E3 17:57:08.<.<ACK>	The host starts the transfer as master with a receive request (enquiry). The ES system answers o.k. (acknowledge) for being ready and sends the first structure data set (request data). The host responds by o.k. (acknowledge) for having understood.
17:57:08.<.<ENQ> 17:57:08.>.<ACK> 17:57:08.>.<STX>EP=MD:18,TY:02,ST:02,IN:14,TC:06,RS:06,RR:20,N .....+A:16,VN:12,GE:10,KL:14,VD:03,UN:08,RT:16,AM:06,AX:0 .....+6,AY:06,AZ:06,AI:05;<ETX>70 17:57:09.<.<ACK>	The host requests a new request data set. The ES system answers o.k. (acknowledge) for being ready and directly sends the next structure data set.
17:57:09.<.<ENQ> 17:57:09.>.<ACK> 17:57:09.>.<STX>EP=HD:03,II:10,ON:10,DA:08;<ETX>49 17:57:09.<.<ACK>	Third structure data set.
17:57:09.<.<ENQ> 17:57:09.>.<ACK> 17:57:09.>.<STX>ED=HD:03,ES300.....,Centner...,19910303;<ETX>4 .....+3 17:57:09.<.<ACK>	Using the same kind of protocol the first result data set (=header data set) with global information is now transferred from the ES system to the host.

17:57:09.<.<ENQ> 17:57:09.>.<ACK> 17:57:09.>.<STX>ED=MD:18, RL ,0.,.....,DIGO.,.... .,+.....,.....,..... .,+.....,.....,....,NMOL/L.,. .....+.....,.....1.,.....1.,.....,.....;<ETX>50 17:57:10.<.<ACK>	The upload data is sent test by test. Each test starts with a blank value (RL=Reagent Blank).
17:57:10.<.<ENQ> 17:57:10.>.<ACK> 17:57:10.>.<STX>ED=MD:18, ST ,32,.....,DIGO.,.3.00 .,+.....,.....,..... .,+.....,.....,....,NMOL/L.,..TOXIC .....+.....,0.002.,0.003.,0.000.,.....,146.;<ETX>82 17:57:11.<.<ACK>	After the blank value all standard values (ST) are sent. First standard.
.
17:57:13.<.<ENQ> 17:57:13.>.<ACK> 17:57:13.>.<STX>ED=MD:18, ST ,32,.....,DIGO.,.3.00 .,+.....,.....,..... .,+.....,.....,....,NMOL/L.,..TOXIC .....+.....,0.002.,0.003.,0.001.,.....,150.;<ETX>7E 17:57:14.<.<ACK>	Last standard.
17:57:14.<.<ENQ> 17:57:14.>.<ACK> 17:57:14.>.<STX>ED=MD:18, PR ,30,Patient-Id-001,DIGO.,.3.00.,Re .....+mark-Request-1.....,Patient-Name-1.,First-Name-1,19 .....+901011.,Ward/Station-1,1.,NMOL/L.,..TOXIC .....+.....,0.002.,0.002.,.....,.....,1.....;<ETX>1E 17:57:15.<.<ACK>	After the standard values the patient results (PR) are sent.
. . . .	After the last patient result for this test the next test will be sent starting with the blank result. ..
17:57:17.<.<ENQ> 17:57:18.>.<ACK> 17:57:18.>.<STX>ED=MD:18, PR ,31,Patient-Id-005,CORT.,.60.00.,Re .....+mark-Request-5.....,Patient-Name-5.,First-Name-5,19 .....+901019.,Ward/Station-5,1.,nmol/l.,..... .....+.....,0.001.,0.001.,.....,.....,143.;<ETX>3E 17:57:18.<.<ACK>	Last patient result for the last test.

17:57:18.<.<ENQ> 17:57:18.>.<ACK>.....!!!!!! 17:57:18.>.<EOT>	<p>If there are no more results the ES system sends an acknowledge and an end of transmission.</p> <p>Note: Normally , this <ACK> should not occur. This is a bug of TWIN software 1.1x and will be eliminated with version 1.2.</p>
17:57:18.....Transmission.finished.----	

5.3. ES33

5.3.1. ES33 Operated in Master Mode

5.3.1.1. ES33: Master Mode - Download Trace

Host-Interface- Test..Version.1.0.....03/03/1991 Slave.....»--»Download.»-- >.....Master local.system..(Host.)...(COM1:9600,n,8,1,- ,0)....remote.system.(ES33) ----- ----- 22:06:07.....Transmission.started.---	This is a trace of the host interface test program.
22:06:07.>.<ENQ> 22:06:07.<.<ACK> 22:06:07.<.<STX>ED=RQ:02,Patient1.....,T3...;<ETX>48 22:06:07.>.<ACK>	The ES system initiates the transfer of a receive request (enquiry). The host responds by o.k. (acknowledge) and sends the first or next request data set directly. The ES system responds by o.k. (acknowledge) for having understood
22:06:07.>.<ENQ> 22:06:07.<.<ACK> 22:06:07.<.<STX>ED=RQ:02,Patient2.....,T3...;<ETX>49 22:06:07.>.<ACK>	and asks for the next receive request. This procedure is repeated until all request data sets are sent from host to ES system.
22:06:07.>.<ENQ> 22:06:07.<.<ACK> 22:06:08.<.<STX>ED=RQ:02,Patient3.....,T3...;<ETX>4A 22:06:08.>.<ACK>	... etc. ...
22:06:08.>.<ENQ> 22:06:08.<.<EOT>	until the host sends an end of transmission indicating that there are no more requests.
22:06:08.....Transmission.finished.(00:00:02)-----	

5.3.1.2. ES33: Master Mode - Upload Trace

Host-Interface- Test..Version.1.0.....03/03/1991 Slave.....<--«..Upload..«-- «.....Master local.system..(Host.)...(COM1:9600,n,8,1,- ,0)....remote.system.(ES33) ----- ----- 22:07:14.....Transmission.started.----	This is a trace of the host interface test program.
---	---

22:07:17.>><DLE> 22:07:17.<<<ACK> 22:07:17.>><STX>EP=RQ:02,IN:14,TC:05;<ETX>13 22:07:17.<<<ACK>	The ES Analyzer System starts the transfer as master with a send request (data link escape). The host responds by o.k. (acknowledge) for being ready. The ES system sends the first structure data set (request data). The host responds by o.k. (acknowledge) for having understood.
22:07:17.>><DLE> 22:07:17.<<<ACK> 22:07:17.>><STX>EP=MD:07,IN:14,TC:05,TY:02,RS:06,UN:06,ST:02,D .....+A:08;<ETX>1D 22:07:17.<<<ACK>	The ES system requests a new send data set. The host responds by o.k. (acknowledge) for being ready so that the ES system can send the next structure data set.
22:07:17.>><DLE> 22:07:17.<<<ACK> 22:07:17.>><STX>ED=MD:07,Standard...a...,T3...,ST,...0.14,ng/ml. .....+,...,05021990;<ETX>1E 22:07:18.<<<ACK>	The upload data is sent test by test. Each test starts with the standard values (ST=Standard).
22:07:18.>><DLE> 22:07:18.<<<ACK> 22:07:18.>><STX>ED=MD:07,Standard...b...,T3...,ST,...0.69,ng/ml. .....+,...,05021990;<ETX>29 22:07:18.<<<ACK>	Second standard.
..
22:07:19.>><DLE> 22:07:19.<<<ACK> 22:07:19.>><STX>ED=MD:07,Standard...e...,T3...,ST,...6.20,ng/ml. .....+,...,05021990;<ETX>25 22:07:19.<<<ACK>	Last standard.
22:07:19.>><DLE> 22:07:19.<<<ACK> 22:07:19.>><STX>ED=MD:07,PN-IM.....,T3...,CO,...1.60,ng/ml. .....+,...,05021990;<ETX>40 22:07:20.<<<ACK>	After the standard values the control values (CO) are sent.
22:07:20.>><DLE> 22:07:20.<<<ACK> 22:07:20.>><STX>ED=MD:07,Patient1.....,T3...,PA,...3.86,ng/ml. .....+,I2,05021990;<ETX>C9 22:07:20.<<<ACK>	Then the patient results (PA) are sent.
22:07:21.>><DLE> 22:07:21.<<<ACK> 22:07:21.>><STX>ED=MD:07,Patient3.....,T3...,PA,...3.67,ng/ml. .....+,I2,05021990;<ETX>CA 22:07:21.<<<ACK>	Last patient result of the test.

22:07:21.>.<DLE> 22:07:21.<.<ACK>.....!!!!!! 22:07:21.>.<EOT> .....!.Syntax.error:.Waiting.for.STX -----.No.error.at.MSTEP.2.1.!	If there are no more results the ES system should send an <EOT> (end of transmission). Note: Normally , this <DLE> should not occur. This is a bug of MSTEP software 2.1x and will be eliminated if ther will be a future version.
22:07:21.....Transmission.finished.(00:00:07)-----.	

6. List of Figures and Tables

Figure 1.1: ES300 host communication concept.	2
Figure 1.2: ES33 host communication concept.	2
Figure 2.1a: Configuration of an EPSON AX2e for TWIN.	6
Figure 2.1b: Configuration of an 486 computer for TWIN (Checkit is patched to recognize XPORT3).	7
Figure 2.2a: Interrupt usage of an EPSON AX2e for TWIN.	7
Figure 2.2b: Interrupt usage of an 486 computer for TWIN (Checkit is patched to recognize XPORT3).	8
Figure 2.3a: Devices of an EPSON AX2e for TWIN listed by the QNX 'mount' command.	9
Figure 2.3b: Devices of an 486 computer for TWIN listed by the QNX 'mount' command.	9
Figure 3.1: TWIN: Welcome screen (LOGIN).	13
Figure 3.2: TWIN: Main menu.	14
Figure 3.3: TWIN: Main menu.	15
Figure 3.4: TWIN: System parameter - Lab. computer setup.	15
Figure 3.5: TWIN: System parameter - setup communication	18
Figure 3.6: TWIN: Select record requisitions	20
Figure 3.7: TWIN: Start download.	20
Figure 3.8: TWIN: Select documentation.	21
Figure 3.9: TWIN: Start upload to lab. EDP.	21
Figure 3.10: TWIN: Select system status.	22
Figure 3.11: TWIN: Table with system status.	24
Figure 3.12: TWIN: Select trace of host communication.	25
Figure 3.13: TWIN: Host communication trace	25
Figure 3.14: MSTEP: Welcome screen.	26
Figure 3.15: MSTEP: Configuration menu.	27
Figure 3.16: MSTEP: Host setup screen.	27
Figure 3.17: MSTEP: Select record requisitions	29
Figure 3.18: MSTEP: Start download.	30
Figure 3.19: MSTEP: Transfer in process.	30
Figure 3.20: MSTEP: Select host upload.	31
Figure 3.21: MSTEP: Start upload to lab. EDP.	31
Figure 3.22: Batchjob to save MSTEP-results for upload (SAVEHOST.BAT).	32
Figure 3.23: Batchjob to restore MSTEP-results for upload (LOADHOST.BAT).	32
Figure 3.24: MSTEP: Transfer in process.	32
Figure 3.25: Print out MSTEP host link trace	33
Figure 4.1: Elements of data transmission	35
Figure 4.2a: Composition of an information string	38
Figure 4.2b: Calculation of the block check code	38
Figure 4.3: Composition of a control code string.	39
Figure 4.4: Master sends data to slave.	41
Figure 4.5: Possible response to different control codes.	43
Figure 4.6: Master receives data.	44



INSTRUMENTATION DIAGNOSTICA
Technical Product Management and Service

Appendix to

Enzymun - Test® Systems

HOST Interfaces

TWIN 1.93 - TWIN 4.0

This document replaces the earlier appendices version 1.0 from August 1993 and version 2.0 from September 1994.

Version 2.1 - Nov.1994

Number of pages: 19
HOHA94B1.DOC

TWIN Host Handler - History of Result Field Representation

The host communication handler for TWIN300 and TWIN600/700 version 1.93 as well as the version 4.0 replace all former host handler updates (HOHA) made for TWIN300 version 1.3 and TWIN600/700 version 1.2. The host handler of TWIN AL300 version 3.1 corresponds to the TWIN300 version 1.93.

The host communication module is identical for TWIN300 and TWIN600/700 software within one release.

<i>History ES Host Interface</i>			
<i>TWIN Version</i>	<i>Representation</i>	<i>Corresponding</i>	<i>Year</i>
DEC User Software 2.1 (ES 600)	RS:06	= R1	1989
	RS:08	= R2	1991
TWIN 1.3 (ES 300)	RS:06	= R3	1992
TWIN 1.2 (ES 600/700)	RS:08	= RA	
(Host Update for 1.2 & 1.3)	RS:08 RA:08	= RS = RA	1992
TWIN Update 1.92 & 1.93 (ES 300/600/700)	RS, RA, R1, R2 A0, A1, A2, A3		2/94
TWIN AL300 3.1	RS, RA, R1, R2 A0, A1, A2, A3		4/94
TWIN AL/NL 4.0 (ES 300/600/700)	+ R3		10/94

An explanation of the history above will be found on next page.

It is recommended to use **RA:08** as result field representation.

History of Result Field Representation:

☞ **DEC User Software:** *(RS, max. lenght 6 ☐ compatibility field R1)*

The result field RS within the DEC User Software is a numerical result.

☞ **TWIN300 Release 1.13:** *(RS, max. lenght 8 ☐ compatibility field R2)*

The result field RS within TWIN300 version 1.13 is a mixture of numerical and alphanumerical results (incompatible with the DEC User Software for ES600).

☞ **TWIN300 Release 1.3 without Host-Update:** *(RS identical to field RA)*

With TWIN300 version 1.3 the result field RS is consequently changed into an alphanumerical field. The numerical value is added by the so called print flag which marks results out of normal range ('>' and '<' -marks).

☞ **Host-Update for TWIN300 Release 1.3 and TWIN600/700 Release 1.2:** *(introd. of compatib. fields R1 and R2, representation of RS and RA exchanged)*

Problems now with existing ES600 host connections resulted in a host communication update. The result field RS is renamed into RA (alphanumerical result) and the 'new' field RS (numerical result) for pure numerical values is created. Additionally, to avoid checking status flags on the host side it is agreed on that only valid results will be sent to the host. Otherwise the result field will be empty.

In case the host can not understand R1, R2 or RA in the structure definition set (see menu *LAB COMPUTER SETUP*) the conversion table **dcom.para** was introduced. To be activated this file must exist in the directory */user/twin*.

☞ **TWIN300/600/700 Update 1.93:** *(to avoid wrong result representation, skip results which do not fit field length)*

The practical experience with different realizations of host communication on host side showed the differences and incompatibility between the existing host communication versions. The introduction of some more parameters and some other add on's now introduce more compatibility to older ES-software versions.

☞ **TWIN AL300 3.1:** *(software for autoloader ES300)*

The result field representations are identical to those of TWIN300 version 1.93.

☞ **TWIN300/600/700 Release 4.0** *(introduction of compatibility field R3)*

For TWIN 1.3 some host realizations changed to alphanumeric result representation with the length 6 only (RS:06) without using the host update. These results were cut in length in case if they were longer than 6 characters. To avoid wrong results those fields were empty in the succeeding version. To make compatible to such versions the field R3 was introduced (compatible to TWIN 1.3 without host update).

Result Representation:

	DEC Softw. compatible	TWIN 1.13 compatible	TWIN 1.3 & 1.2 Host Update and TWIN 1.93 definitions			TWIN 1.3 compatible	Remark
	R1:06 A0,A1,A2,A3	R2:06 AM,AX,AY,AZ	RS:06 AM,AX,AY,AZ	RA:06 AM,AX,AY,AZ	RA:08 AM,AX,AY,AZ	R3:06 AM,AX,AY,AZ	Rn: result An: absorbance
	numerical	alpha-num.	numerical	alpha-num.	alpha-num.	alpha-num.	
Cutoff:	´+1.....´	´POS...´	´+1.....´	´.POS...´	´.POS.....´	´.POS...´	Rn only
	´0.....´	´GREY...´	´0.....´	´.GREY...´	´.GREY.....´	´.GREY...´	
	´-1.....´	´NEG...´	´-1.....´	´.NEG...´	´.NEG.....´	´.NEG...´	
empty field:	´-99999´	´.....´	´.....´	´.....´	´.....´	´.....´	
invalid values:	´-99999´	´.....´	´.....´	´.....´	´.....´	´.....´	
zero values:	´0.00...´	´0.00...´	´0.00...´	´.0.00...´	´.0.00...´	´.0.00...´	
normal range value:	´1.23...´	´1.23...´	´1.23...´	´.1.23...´	´.1.23...´	´.1.23...´	
	´100000´	´100000´	´100000´	´.....´	´.100000...´	´.10000´	
	´123.56´	´123.56´	´123.56´	´.....´	´.123.56...´	´.123.5´	
value < 0:	´-99999´	´*****´	´.....´	´*****´	´*****´	´*****´	
value < lower standard:	´0.10...´	´0.10...´	´.....´	´<0.10...´	´<0.10...´	´<0.10...´	
value > upper standard:	´2.00...´	´2.00...´	´.....´	´>2.00...´	´>2.00...´	´>2.00...´	
				´.....´	= does not fit field length => use greater length		

Example for result representation:

IN:14	TC:06	RS:06	RA:08	R1:06	R2:08	ST:02	AM:08	AX:08	TY:02	AI:03
.....	TSH...	.....	.....	.....	.....	0.	.189....	.189....	RL	...
.....	TSH...	0.00..	•0.00...	0.00..	0.00....	22	0.022...	0.022...	ST	146
.....	TSH...	0.29..	•0.29...	0.29..	0.29....	22	0.053...	0.053...	ST	147
.....	TSH...	2.23..	•2.23...	2.23..	2.23....	22	0.279...	0.279...	ST	148
.....	TSH...	13.91.	•13.91..	13.91.	13.91....	22	1.556...	1.556...	ST	149
.....	TSH...	39.20.	•39.20..	39.20.	39.20....	22	3.391...	3.391...	ST	150
.....	TSH...	1.67..	•1.67...	1.67..	1.67....	22	0.213...	0.213...	CO	151
Patient001....	TSH...	.....	>39.20..	39.20.	39.20....	31	9.999...	>>>>>>	PR	1..
Patient002....	TSH...	35.75.	•35.75..	35.75.	35.75....	30	3.198...	3.198...	PR	2..
Patient003....	TSH...	30.51.	•30.51..	30.51.	30.51....	30	2.875...	2.875...	PR	3..
Patient004....	TSH...	7.30..	•7.30...	7.30..	7.30....	30	0.870...	0.870...	PR	4..
Patient005....	TSH...	4.01..	•4.01...	4.01..	4.01....	30	0.491...	0.491...	PR	5..
Patient006....	TSH...	2.89..	•2.89...	2.89..	2.89....	22	0.358...	0.358...	PR	6..
Patient007....	TSH...	0.24..	•0.24...	0.24..	0.24....	22	0.048...	0.048...	PR	7..
Patient008....	TSH...	0.17..	•0.17...	0.17..	0.17....	30	0.040...	0.040...	PR	8..
Patient009....	TSH...	0.00..	•0.00...	0.00..	0.00....	30	0.020...	0.020...	PR	9..
Patient010....	TSH...	0.00..	•0.00...	0.00..	0.00....	30	0.000...	0.000...	PR	10.
Patient011....	TSH...	0.00..	•0.00...	0.00..	0.00....	30	-0.058..	-0.058..	PR	11.

IN:14	TC:06	RS:06	RA:08	R1:06	R2:08	ST:02	AM:08	AX:08	TY:02	AI:03
.....	T4....	.....	.....	.....	.....	0.	.189....	.189....	RL	...
.....	T4....	0.04..	.0.04...	0.04..	0.04....	22	1.658...	1.658...	ST	141
.....	T4....	3.79..	.3.79...	3.79..	3.79....	22	0.834...	0.834...	ST	142
.....	T4....	7.65..	.7.65...	7.65..	7.65....	22	0.477...	0.477...	ST	143
.....	T4....	13.12.	.13.12..	13.12.	13.12...	22	0.315...	0.315...	ST	144
.....	T4....	.....	>24.80..	24.80.	24.80...	31	0.222...	0.222...	ST	145
.....	T4....	5.73..	.5.73...	5.73..	5.73....	22	0.606...	0.606...	CO	151
Patient001....	T4....	0.00..	.0.00...	0.00..	0.00....	30	9.999...	>>>>>>	PR	1..
Patient002....	T4....	0.91..	.0.91...	0.91..	0.91....	30	1.493...	1.493...	PR	2..
Patient003....	T4....	3.57..	.3.57...	3.57..	3.57....	30	0.870...	0.870...	PR	3..
.....	T4....	5.80..	.5.80...	5.80..	5.80....	22	0.600...	0.600...	CO	151
Patient004....	T4....	4.49..	.4.49...	4.49..	4.49....	30	0.736...	0.736...	PR	4..
Patient005....	T4....	4.52..	.4.52...	4.52..	4.52....	22	0.732...	0.732...	PR	5..
Patient006....	T4....	6.91..	.6.91...	6.91..	6.91....	22	0.519...	0.519...	PR	6..
.....	T4....	5.87..	.5.87...	5.87..	5.87....	22	0.594...	0.594...	CO	151
Patient007....	T4....	11.87.	.11.87..	11.87.	11.87...	30	0.338...	0.338...	PR	7..
Patient008....	T4....	12.12.	.12.12..	12.12.	12.12...	30	0.333...	0.333...	PR	8..
Patient009....	T4....	21.77.	.21.77..	21.77.	21.77...	30	0.236...	0.236...	PR	9..
.....	T4....	5.93..	.5.93...	5.93..	5.93....	22	0.589...	0.589...	CO	151
Patient010....	T4....	.....	>24.80..	24.80.	24.80...	31	0.218...	0.218...	PR	10.
Patient011....	T4....	.....	>24.80..	24.80.	24.80...	31	0.186...	0.186...	PR	11.

IN:14	TC:06	RS:06	RA:08	R1:06	R2:08	ST:02	AM:08	AX:08	TY:02	AI:03
.....	TBK...	.....	.....	.....	.....	0.	.189....	.189....	RL	...
.....	TBK...	0.32..	.0.32...	0.32..	0.32....	22	1.429...	1.429...	ST	139
.....	TBK...	1.75..	.1.75...	1.75..	1.75....	22	0.534...	0.534...	ST	140
Patient001....	TBK...	.....	>1.75...	1.75..	1.75....	31	0.066...	0.066...	PR	1..
Patient002....	TBK...	.....	>1.75...	1.75..	1.75....	31	0.348...	0.348...	PR	2..
Patient003....	TBK...	1.75..	.1.75...	1.75..	1.75....	30	0.534...	0.534...	PR	3..
Patient004....	TBK...	1.45..	.1.45...	1.45..	1.45....	30	0.722...	0.722...	PR	4..
Patient005....	TBK...	1.36..	.1.36...	1.36..	1.36....	22	0.781...	0.781...	PR	5..
Patient006....	TBK...	1.10..	.1.10...	1.10..	1.10....	22	0.941...	0.941...	PR	6..
Patient007....	TBK...	0.84..	.0.84...	0.84..	0.84....	22	1.103...	1.103...	PR	7..
Patient008....	TBK...	0.77..	.0.77...	0.77..	0.77....	30	1.149...	1.149...	PR	8..
Patient009....	TBK...	0.61..	.0.61...	0.61..	0.61....	30	1.250...	1.250...	PR	9..
Patient010....	TBK...	.....	<0.32...	0.32..	0.32....	31	1.484...	1.484...	PR	10.
Patient011....	TBK...	.....	<0.32...	0.32..	0.32....	31	1.497...	1.497...	PR	11.
Patient012....	TBK...	.....	>1.75...	1.75..	1.75....	31	-0.686..	-0.686..	PR	12.

IN:14	TC:06	RS:06	RA:08	R1:06	R2:08	ST:02	AM:08	AX:08	TY:02	AI:03
.....	AHIVG.	.....	.....	.....	.....	0.	.189....	.189....	RL	...
.....	AHIVG.	-1....	•NEG....	-1....	NEG....	22	0.061...	0.061...	ST	137
.....	AHIVG.	+1....	•POS....	+1....	POS....	22	2.348...	2.348...	ST	138
Patient001....	AHIVG.	+1....	•POS....	+1....	POS....	22	9.999....	>>>>>>	PR	1..
Patient002....	AHIVG.	+1....	•POS....	+1....	POS....	22	1.873...	1.873...	PR	2..
Patient003....	AHIVG.	+1....	•POS....	+1....	POS....	22	0.870...	0.870...	PR	3..
Patient004....	AHIVG.	+1....	•POS....	+1....	POS....	22	0.241...	0.241...	PR	4..
Patient005....	AHIVG.	+1....	•POS....	+1....	POS....	22	0.232...	0.232...	PR	5..
Patient006....	AHIVG.	0....	•GREY...	0....	GREY....	22	0.222...	0.222...	PR	6..
Patient007....	AHIVG.	0....	•GREY...	0....	GREY....	22	0.206...	0.206...	PR	7..
Patient008....	AHIVG.	-1....	•NEG....	-1....	NEG....	22	0.199...	0.199...	PR	8..
Patient009....	AHIVG.	-1....	•NEG....	-1....	NEG....	22	0.146...	0.146...	PR	9..
Patient010....	AHIVG.	-1....	•NEG....	-1....	NEG....	22	0.020...	0.020...	PR	10.
Patient011....	AHIVG.	-1....	•NEG....	-1....	NEG....	22	-0.132..	-0.132..	PR	11.

1. Result Field Representation with TWIN 1.93 or Successor Version:

It is recommended to use **RA:08** as result field representation.

- R1:** If an existing host only accepts the RS representation of DEC User Software release 2.1 then R1 with TWIN 1.93 or successor version should be used.
- R2:** If an existing host only accepts the RS representation of TWIN 300 User Software release 1.13 then R2 with TWIN 1.93 or successor version should be used.
- R3:** If an existing host only accepts the RS:06 representation of TWIN 300 User Software release 1.3 without host update then
- with TWIN 1.93 the host handler of version 1.3 should be used (setup with the *Host Selection Upate*)
 - with TWIN 4.0 or successor version the field R3 should be used.
- (This compatibility field only should be used in case of RS with length 6, otherwise RA for lenght greater than 6. With RA:06 some results might be skipped because the value does not fit the field lenght 6. This field will be available since version 4.0, not for version 1.93.)
- RS:** specification: RS is a pure numerical field
(this field was introduced with host-update for TWIN releases 1.2 & 1.3)
- RA:** specification: RA is an alphanumerical field:
(this field was introduced with host-update for TWIN releases 1.2 & 1.3 and is identical to the field RS of TWIN releases 1.2 & 1.3)
the first character of the RA-field was introduced to characterize the result with the so called print flag (refer to labelling of results).
- A0:** compatible to DEC User Software
(corresponds to mean absorbance AM)
- A1:** compatible to DEC User Software
(corresponds to absorbance AX)
- A2:** compatible to DEC User Software
(corresponds to absorbance AY)
- A3:** compatible to DEC User Software
(corresponds to absorbance AZ)

2. Short Fields:

In the case that the result field length is not long enough to hold the measured value the '**invalid value**' will be used.

Example:

Result	RS:06	RA:06 1. character print flag	RS:08	RA:08 1. character print flag
123.45	´123.45´	´.....´	´123.45..´	´.123.45.´
NEGATIV	´-1....´	´.....´	´-1.....´	´.NEGATIV´

3. Default Values:

Differences for the default values (**invalid value** and **empty field**):

R1: Default value for uncalculated results: ´-99999´.

R2: Default value for uncalculated results: ´.....´.

R3: Default value for uncalculated results: ´.....´.

RS: Default value for uncalculated results: ´.....´.

RA: Default value for uncalculated results: ´.....´.

[A0, A1, A2, A3]: Default value for uncalculated results: ´-99999´.

[AM, AX, AY, AZ]: Default value for uncalculated results: ´.....´.

4. Reagent Blank:

The result (=concentration) for reagent blank (variable type TY:02 = ´RL´) will not be transmitted in the TWIN software (see example).

IN:12	TC:06	RA:08	ST:02	AM:08	AX:08	TY:02	AI:03;
.....	TSH...	.....	0.	.189....	.189....	RL	...;

5. Receive Buffer And Communication Error:

After a communication error during downloading requests the receive buffer will not be emptied as in older host communication versions. Request data sets having the right data structure will be transferred to the data base (DEC User Software compatibility).

Example:

During the receipt of requests the DEC User Software accepts requests if the host finishes the communication with **<ACK><EOT>**. This does not fulfill the protocol rules, however the transmitted data are O.K..

ES-System		Host	
<ENQ>	-->		
	<--	<ACK>	
	<--	<STX>P=RQ	
<ACK>	-->		
<ENQ>	-->		
	<--	<ACK>	Wrong.
	<--	<EOT>	

6. Send Buffer And Receive Buffer:

Now both buffers can be deleted from QNX level (Send-Result-Buffer = **F_SERE**, Receive-Request-Buffer = **F_RERE**). A buffer not existing will be initialized without any error message.

(Background: Within TWIN both buffers are ASCII-files. Missing a buffer file had result in an error abortion. This was changed for update host update).

7. System Status:

There is a different system status handling between DEC User Software and TWIN. TWIN only uses the flags 40 to 43 (= release flags) to control results for upload.

The two release flags (menu *SYSTEM PROGRAMMING - SYSTEM STATUS - Upload Flag*)

41 = 'Rerun' and

42 = 'Result blocked by operator'

will be sent as result status (field ST) to the host.

The two release flags

40 = 'Result released by operator' and

43 = 'Result released'

will never appear at the host. Instead of these the test status 21-36 will be sent as status to the host.

(Background: Normally for TWIN not release flags but the status which leads to the release will be sent to the host.)

8. Limited Host Communication Trace:

The host communication trace will be erased if a new run is started. During the start up process it will be limited to 500 records.

(Background: The host communication trace list will be stored on the run data diskette. A very long trace produces a data overflow on the diskette).

9. Busy Files:

Host communication is divided into two steps:

1. the data transmission from/to the host via serial communication and
2. the data transfer into/from the data base via data base update.

Because of simultaneous file access to the buffer files from both processes conflicts may appear. Therefore especially for slave mode results the following behaviour was realized:

During an active data transmission no data sets can be written into the upload buffer file (*'Upload not possible'*).

During the data transfer into the upload buffer no data transmission can be started. The host gets a **<EOT>**=*'End of Transmission'* .

10. Conversion Table For Result Abbreviations:

If using result field representations R1, R2, R3 or RA in the structure definition data set for measure data (P=MD...) it may happen that the host does not understand R1, R2, R3 or RA, however the host expects the corresponding result format. E.g., instead of R1 the host only understands RS.

For this purpose the conversion table (**dcom para**) allows to transfer another parameter (R1, R2, R3, RA) than it is defined in the data structure set (P=MD:05,RS:06...).

The file **/user/twin/dcom para** does not exist by default!.

To simplify the installation of **dcom para** there is a program **host** which allows to select the needed result type. This special program is available with the *Host Selection Update* and since TWIN version 4.0 with the User Software.

Example for TWIN 1.93:

Insert the diskette *Host Selection Update* and execute the command 1:/update. From now on at '\$'-prompt execute the program 'host' to change the result representation:

```
=====
                        Host Driver Selection For TWIN 1.93
                        Version for ES 300/600/700
                        all language versions
=====

  Option   Setup   Result   Compatibility           Conversion   Host
-----
    1:  RA:08             recommendation (default)   none         1.93
    2:  RS:08      RA    TWIN 1.3 w/o Host Update  dcom.130.8   1.93
    3:  RS:06      RS    TWIN 1.3 w/o Host Update  none         1.3
    4:  RS:06      R2    TWIN 1.13                 dcom.113     1.93
    5:  RS:06      R1    DEC User Software         dcom.dec     1.93

  H:  Help
  0:  Exit without change
-----

Select option and hit [ENTER] ...5
```

```
=====
                        Host Driver Selection For TWIN 1.93
                        Version for ES 300/600/700
                        all language versions
=====

  Option   Setup   Result   Compatibility           Conversion   Host
-----
    1:  RA:08             recommendation (default)   none         1.93
    2:  RS:08      RA    TWIN 1.3 w/o Host Update  dcom.130.8   1.93
    3:  RS:06      RS    TWIN 1.3 w/o Host Update  none         1.3
    4:  RS:06      R2    TWIN 1.13                 dcom.113     1.93
    5:  RS:06      R1    DEC User Software         dcom.dec     1.93
-----

dcom.dec copied to dcom.para.  HOHA.193 (version 1.93) copied to HOHA.

Host Driver Option 5 installed (compatible to DEC User Software).

After re-installing TWIN do not forget to execute host again.
Please adjust your host software to RA:08 with the next host software update.

Please reboot the system: [CTRL-ALT-SHIFT-DEL].
```

Example for TWIN 4.0:

At '\$'-prompt execute the program 'host' to change the result representation:

```
=====
                        Host Driver Selection For TWIN 4.x
                        Version for ES 300/600/700
                        all language versions
=====
Option   Setup   Result   Compatibility   Conversion table
-----
  1:  RA:08
  2:  RS:08      RA      TWIN 1.3 w/o Host Update  dcom.130.8
  3:  RS:06      R3      TWIN 1.3 w/o Host Update  dcom.130.6
  4:  RS:06      R2      TWIN 1.13                  dcom.113
  5:  RS:06      R1      DEC User Software         dcom.dec

H:  Help
0:  Exit without change
-----

Select option and hit [ENTER] ... 3
```

```
=====
                        Host Driver Selection For TWIN 4.x
                        Version for ES 300/600/700
                        all language versions
=====
Option   Setup   Result   Compatibility   Conversion table
-----
  1:  RA:08
  2:  RS:08      RA      TWIN 1.3 w/o Host Update  dcom.130.8
  3:  RS:06      R3      TWIN 1.3 w/o Host Update  dcom.130.6
  4:  RS:06      R2      TWIN 1.13                  dcom.113
  5:  RS:06      R1      DEC User Software         dcom.dec
-----

dcom.130.6 copied to dcom.para.

Host Driver Option 3 installed (compatible to TWIN 1.3 w/o Host Update).

After re-installing TWIN do not forget to execute host again.
Please adjust your host software to RA:08 with the next host software update.

Please reboot the system: [CTRL-ALT-SHIFT-DEL].
```

11. Remote Access:

All program files needed for modem control and bi-directional file transfer will be delivered in the newer versions (**comm** and **qcp**).

The system initialization (*sys.init*) calls up a modem initialization script (*/config/modem.init*) to setup serial port \$term4 (=COM5) for modem connection.

The baudrate has to be adapted to the modem speed.

```
"
" Initialize port $term4 for remote terminal
"
stty < $term4 > $null >* $null
if ne #? 0000 exit
stty baud=9600 par=none stop=1 bits=8 +fix > $term4
ontty $term4 comm b=9600 +h l=3:/tmp
```

12. Limit Check For Requests:

The host communication handler does **not** check the limits for the maximum number of requests. This must be done from the host software.

Limits are:	TWIN 700	500 requests/test	3000 requests
	TWIN 300	300 requests/test	2000 requests

Host Parameters:

No.	Description	Code	Type	Length	Default	Comment
				Max.		Max.: maximal length
<i>Variables for Download and Upload</i>						
1.	Ident Number	IN	A	18	-	no leading and no internal spaces
2.	Test Code	TC	A	6	-	
3.	Test Number	TN	I	2	-	valid range [1..99]
4.	Remark Request	RR	A	40	-	
5.	Ward	KL	A	16	HOST	
6.	Patient Name	NA	A	20	-	
7.	First Name	VN	A	16	-	
8.	Sex 0 = unknown 1 = male 2 = female 3 = child	SX	I	2	0	valid range [0..3]
9.	Date of Birth Format = YYYYMMDD or Format = YYMMDD	GE	I	8	-	The date can have the length 6 or 8.
10.	Dilution Factor	VD	I	5	1	valid range [1..99999]
11.	Patient Address	PA	A	60	-	
12.	Prevalue 1	PV	R	8	-	only dummies, will not be used internally
13.	Prevalue 2	PX	R	8	-	
14.	Prevalue 3	PY	R	8	-	
<i>Variables for Upload</i>						
15.	Instrument Identification	II	A	10	-	
16.	Operator Name	ON	A	20	-	
17.	Date Format = YYYYMMDD or Format = YYMMDD	DA	A	8	-	The date can have the length 6 or 8.

No.	Description	Code	Type	Length	Default	Comment
				Max.		Max.: maximal length
<i>Variables for Upload (continue)</i>						
18.	Result	RS	R	8	-	numerical result
19.	Alphanumeric Result	RA	A	8	-	alphanumeric result
20.	Numerical Result (DEC User Software compatible)	R1	R	8	-	numerical result
21.	Alphanumeric Result (TWIN 1.13 compatible)	R2	A	8	-	alphanumeric result
22.	Alphanumeric Result (TWIN 1.3 compatible)	R3	A	8	-	only to use for compatibility
23.	Unit	UN	A	10	-	
24.	Status	ST	I	2	-	valid range [8,20-36]
25.	Type RL = Reagent Blank (Subst. or Water) ST = Standard CO = Control PR = Patient Result	TY	A	2	-	valid range [RL,ST,CO,PR] During Upload the results will be sent test oriented following the order: 1. Blank Value 2. Standard Value 3. Samples and Controls depending on rotor position
26.	Remark Test	RT	A	12	-	
27.	Control Code	CC	A	10	-	
28.	Lot Number	IO	A	6	-	
29.	Mean Absorbance	AM	A	8	-	depending on the result-labeling
30.	Mean Absorbance (DEC compatible)	A0	R	8	-	
31.	Absorbance Value 1	AX	A	8	-	
32.	Absorbance Value 1 (DEC compatible)	A1	R	8	-	

No.	Description	Code	Type	Length	Default	Comment
				Max.		Max.: maximal length
<i>Variables for Upload (continue)</i>						
33.	Absorbance Value 2	AY	A	8	-	
34.	Absorbance Value 2 (DEC compatible)	A2	R	8	-	
35.	Absorbance Value 3	AZ	A	8	-	
36.	Absorbance Value 3 (DEC compatible)	A3	R	8	-	
37.	Sample Rotor Position	AI	I	3	-	valid range [1-150]

General Field Types:

A alphanumerical field:

Separators like ',' (comma) and ';' (semicolon) are not permitted. Else all printable characters of the ASCII table can be used. Alphanumerical fields will be written as read.

Miscellaneous: Leading spaces must not be used within key fields, like **IN** (identification number) and **TC** (test code).

Especially spaces, commas or periods within the *identification number* or the *test code* must be avoided.

R numerical field:

Valid characters are **0..9**, the decimal point '.', space and '+' and '-' for positive and negative results.

Miscellaneous: If the result is invalid it will be sent as an empty field.

Reading numerical fields, they have not to be right justified or left justified. Leading spaces or zeros will be cut.

Numerical values will be written left justified.

I numerical integer field:

Valid characters are **0..9**.

Miscellaneous: Reading spaces within a numerical field results in a default value (e.g. VD=1 or SX=0).

D date field:

Format is YYYYMMDD or YYMMDD.

Date fields will be read and written left justified (fixed length 6 or 8).

Special Fields:

RS, R1

The numerical result fields RS and R1 are only of the character range [0..9, '.', '+', '-'). Cutoff-results will have '+1' for 'pos'='>', '-1' for 'neg'='<' and '0' for 'border'='='.

Results out of concentration range, where a result label '>', '<' or '*****' should appear the field will be sent as an empty field.

RA, R2, R3

The result fields RA, R2 and R3 are alphanumerical. The result value will be constructed out of the regular measured value following the so called print flag '>', '<' for values out of concentration range or ' ' (space) for valid results.

Depending on the input to the 'result marks' within the menu test applications cutoff values will be sent as '**pos**' for '>', '**neg**' for '<' and ' ' for '=' (border).

Labeling Of Results (RA, RS, AM, AX, AY, AZ) For Upload.

- > / < The calculated value is above/below the highest/lowest standard, or outside the upper/lower extrapolation range. The noted result is the concentration of the highest/lowest standard or the upper/lower extrapolation limit. The host must check status (31).
- ***** The concentration value is below zero. The host must check status.
- <<<<<< The measured absorbance was lower than -1. The host must check status.
- >>>>>> The measured absorbance is higher than the maximum absorbance defined in the test applications. The host must check status.
- The absorbance has not been measured. No valid concentration value has been determined. The host must check status.

Differences between TWIN and DEC User Software:

The DEC user software allows spaces within identification numbers or tests

Separator within a data set:

TWIN reads up to a comma. DEC reads up to a comma and checks the position.

Figure 4.7: Structure of data sets	45
Table 2.1a: Addresses and interrupts of two default serial interfaces and XPORT3-BM.	5
Table 2.1b: Addresses and interrupts of one default serial interface and XPORT3-BM.	5
Table 2.1c: Addresses and interrupts of two default serial interfaces and XPORT3 (old edition).	5
Table 2.2: Default interface assignment for simple bidirectional data transfer.	10
Table 2.3 a: Pin assignment for a host communication cable with two 9-pin plugs.	11
Table 2.3 b: Pin assignment for a host communication cable with two 25-pin plugs.	11
Table 2.3 c: Pin assignment for a host communication cable with one 25-pin and one 9-pin plug.	11
Table 2.4: Pin assignments of 25-pin and 9-pin test adapter plugs.	12
Table 3.1a: TWIN: Parameters to be set for host communication.	16
Table 3.1b: TWIN: Parameters to be set for host communication.	17
Table 3.2a: TWIN: Parameters to be set for host communication.	18
Table 3.2b: TWIN: Parameters to be set for host communication.	19
Table 3.3: TWIN: System status assignment.	22
Table 3.4: TWIN: List of system status assignment.	23
Table 3.5: TWIN: uploadable status numbers.	25
Table 3.6a: MSTEP: Parameters to be set for host communication.	28
Table 3.7b: MSTEP: Parameters to be set for host communication.	29
Table 4.1: ASCII table (American Standard Code for Information Interchange)	34
Table 4.2a: Control characters of data transmission	36
Table 4.2b: Control characters of data transmission	37
Table 4.3: Possible response to different control codes.	42
Table 4.4a: Variables for data transfer	47
Table 4.4b: Variables for data transfer	48
Table 4.5: Different contents of result fields	50