CS82/2 Data Interface Manual

Contents

1. Introduction

About This Manual

This manual contains information about the data interface to IMT System 4000 Software from version 5.1.0. CS82/2 is an extension of the standard CS83 data format, and the description of CS83/2 is placed in this separate manual to obtain the best overview possible.

What is CS83/2 ?

- CS83/2 defines a data format, a file format and a protocol for serial communication.
- CS83/2 is an extension to the standard CS83 data format which FOSS has developed and supported since 1983.
- CS83/2 is in several ways a simplification of the CS83 data format.
- CS83/2 can handle more components per message/file than CS83.
- CS83/2 can handle more result/batch-types than CS83.
- CS83/2 differs only in the data format, the protocol used for serial communication is unchanged.

Where is CS83/2 used ?

CS83/2 data format is currently supported only in IMT System 4000 Software from version 5.1.0.

Why CS83/2 ?

New analysers offers an increasing range of components which poses 2 problems for the standard CS83 data format :

1. Standard CS83 can handle a limited number of components (15) in a serial transmission, or a data file (BAT file).
2. Components are identified by a 2-digit ASCII hexadecimal code (”Prefix code” 00hex-FFhex). The standard CS83 uses the first digit of this prefix-code to indicate the type of a given component, meaning that a single component occupies many prefix-codes. This leads to a shortcoming of prefix-codes.

Do I have to change to CS83/2 ?

In version 5.1.0 of the IMT System 4000 Software, standard CS83 will also be available for backward capability, however please notice that:

> When using Standard CS83, some new components will NOT be available and the total number of components in a measure program must be kept below 15.

2. The CS83/2 data format

Results

Data for one result is always transmitted/stored as one string of ASCII bytes.
Data for one result is split into components. Each component has a fixed length of 14 bytes and contains data for one measured/derived/system-parameter.

A result with 6 components/parameters:

14 bytes	14 bytes	14 bytes	14 bytes	14 bytes	14 bytes

Components

(The formatting of components is unchanged compared to standard CS83)

A *CS83/2 component* consists of 14 bytes.

The first 4 characters is a prefix code used to identify the component and the last 10 characters contains the actual data (right-adjusted).
The prefix identification code has the form ”#XX/” where XX is the actual prefix

Please refer to appendix A for a complete list of CS83/2 prefix codes.

#	0	0	/		>					2	.	3	6

Byte 1 - 4:	**Component prefix**	(#*xx*/ where *xx* is the component code)
Byte 5:	**Sign** byte	(optional)
Byte 6:	**Limit** byte	(optional)
Byte 7 - 14 :	**Data**	

The **Component prefix** is a code used to identify each component.

The **Sign** byte may contain a “-” (2D hex) to indicate a negative value. For positive values the Sign byte contains “space” (20 Hex).

The **Limit** byte may contain a “>” (3E hex) or “<“ (3C Hex) to indicate that a value is out of limit. For values inside limits the Limit byte contains “space” (20 Hex).

In case of a Critical Warning (BactoScan), the Limit byte may contain a “*” (2A Hex).

Critical Warnings are a certain group of warnings where the result may be incorrect due to the warning reported. In the set-up it is decided if such results should be reported or not. If the result is not reported,

the Limit byte will contain “*” and the Data bytes will contain “*****”. Otherwise the Limit byte will contain “*”, and the result is reported in the Data bytes.

The **Data** bytes contain the result. All results are right adjusted and prefixed with spaces.

Examples:

#02/ > 2.33 (14 characters).

This is a protein (#02) result.

The result has exceeded a programmed limit (>).

The result is 2.33.

#F0/ 1012#F3/ 5#01/ 3.34#02/ 2.33
#03/ 4.32

This result has position = 1012	(#F0/ 1012)
The result is the 5’th normal result in the batch	(#F3/ 5)
The Fat B result is 3.34	(#01/ 3.34)
The Protein result is 2.33	(#02/ 2.33)
The Lactose result is 4.32	(#03/ 4.32)

Result Component Sequence

The sequence of the components, and the number of components being transmitted matches the measure set-up being used. This indicates that the data handling software should seek requested components using the component prefix-codes.

NOTICE:

Do **not** assume fixed positions. (E.g. “Fat B is always component number 4 in the sequence”). This assumption will fail if the system-setup is changed

A batch header always contains the components:

#63/ #64/ #65/ #60/ #61/ #62/ #66/ #67/ #68/

Maximum Number of Components in a result

CS83/2 can handle several hundred components per result. It is, however adequate to have an input buffer of 1000 bytes (making room for 70 components).

Special components

SAMPLE-ID Component:

If the system is using bar code-labels, these will be presented in the component

"#69/ " (right adjusted, prefixed by spaces).

If the labels contains more than 10 significant digits, these digits are placed in an "extended-id" component "#6F/ ".

A label containing the digits : **112233445566778899** (18 digits) will be presented as

"#6F/ **11223344**#69/**5566778899**".

SUB NUMERATOR Component:

Example: 2 samples with 4 intakes from each.

Position	Numerator	Sub-numerator (intake number)
887	1	1
887	1	2
887	1	3
887	1	4
888	2	1
888	2	2
888	2	3
888	2	4

RESULT TYPE Component:

From version 3.0 of the S4000 software the Result Type component is available as an extension to the standard CS83, and from version 5.0.0 (CS83/2) this is the only way to determine the type of a result.

The purpose of this component is to enable export to host and disk (.BAT and .EDI formats) of all batch types the S4000 systems can produce. So far only normal batches could be exported.

Using the Result Type component is also a simplification of the CS83 data format since there will no longer be a change in the first prefix character in case of pilot- or zero-samples.

NOTICE:

The RESULT TYPE component is always present in CS83/2 and is added as the first component in each result

The prefix for the Result Type component is **#FF/**

#	F	F	/	A	A	A	E						

Byte 1: **Batch type**

Byte 2: **Result type**

Byte 3: **Bottle type**

Byte 4: Empty sample. (Empty = ‘E’)

Available Batch Types (Byte 1):

This corresponds to the batch type selected in the batch register when keying in the batch.

‘A’ Normal batch

‘B’ Repeatability batch

‘C’ CarryOver MSC batch

‘D’ Zero batch

‘E’ Pilot definition 1 batch

‘F’ Pilot definition 2 batch

‘G’ Pilot definition 3 batch

‘H’ Blind batch (FM)

‘T’ Sample-set batch

‘U’ CarryOver FM batch

‘X’ CarryOver BSC batch

‘Y’ RepeatCheck BSC batch

‘Z’ Blank BSC batch

'a' FMA result (Fossomatic 5000 only)

'b' DC Check (Fossomatic 5000 only)

'c' Bacterial Control Sample (BactoScan FC only)

'd' Particle Control Sample (BactoScan FC only)

Result-types (Byte 2):

This byte describes the type of a result:

‘A’ Normal result	
‘B’ Pilot Deviation result	(Presented for each pilot if deviation check selected)
‘C’ Pilot Mean result	(Shown for each pilot if mean-check selected).
‘D’ Zero Deviation result	(Calculated result of a zero setting).
‘E’ Repeatability Sd result	(Calculated result (Sd) of a repeatability batch)
‘F’ Repeatability Mean result	(Calculated result (mean) of a repeatability batch)
‘G’ CarryOver Old result	(Old carry over result)
‘H’ CarryOver New result	(Calculated result of a carry over batch)
‘I’ Pilot Definition Mean,	(Calculated result of a pilot definition batch)
‘J’ Zero result	(Zero measurements).
‘K’ Blind Mean result	(Calculated result of a blind batch)

Bottle types (Byte 3):

‘A’ Normal bottle	
‘B’ Pilot1 bottle	(Bottle is marked as a Pilot 1 bottle (metal tape).
‘C’ Pilot2 bottle	(Bottle is marked as a Pilot 2 bottle (metal tape).
‘D’ Pilot3 bottle	(Bottle is marked as a Pilot 3 bottle (metal tape).
‘E’ Bottle Missing	(No bottle present)

Empty (Byte 4)

Contains ‘E’ if the sample is empty or contains too little milk to feed both analysers when running a Combi.

Data bytes 5 to 10 are currently not used.

Result type component examples:

‘#FF/AAA ‘ is a normal result from a normal batch, result and bottle.

‘#FF/ACB ‘ is a Pilot Mean result (C) , it is a pilot1 (B) from a Normal batch (A)

‘#FF/ACBE ‘ same as above, but the sample was empty. (E).

Using CS83/2 data files

This chapter is relevant for users of CS83/2 data files (.BAT, .EDI and .CSV files).

Files from System 4000 Software are named as shown below:

File type	8 character filenames	10 character filenames
Batch files	xxxxxxxx.BAT	Xxxxxxx.xxx
Edit files	xxxxxxxx.EDI	Exxxxxx.xxx
CSV files	xxxxxxxx.CSV	Cxxxxxx.xxx

NOTICE:

Local batches cannot be exported to disk.

Batch Files (.BAT)

A CS83/2 batch file consists of a File Descriptor Block which is 384 characters long, followed by the Result Data part of the file. The length of the Result Data part of the file is the number of results multiplied with the length of each result. All results have equal length.

Batch File Descriptor block,
Byte 0 to 383

Batch File Result Data block
Starting at byte 384

Format of the CS83/2 File Descriptor Block

The format of the CS83/2 File Descriptor Block differs in several ways from the standard CS83 File Descriptor Block. These changes were necessary because of the standard CS83 shortcomings mentioned in the introduction. (This also implies that System 4000 batch files are no longer DaCo2/DaCo-SA compatible).

In the following paragraphs it is assumed that byte 0 is the first byte in the File Descriptor Block. Notice that the positions of the following information within the file header has changed compared to standard CS83.

CS83/2 file identification

12 Bytes. Byte 0 to 11. For CS83/2 file headers the file identification will always be

”S4000-2.0 ” (12 bytes, left adjusted).

Batch information length

4 Bytes. Byte 14 to 17. The decimal length of the batch information (which starts at byte 128).
Example ”0126” = 126 bytes (9 components) of batch information.
The number is prefixed with zeros.

Result length

4 Bytes. Byte 20 to 23. The decimal length of each result in the file.
Example: ”0098” 98 bytes = 7 components.
The number is prefixed with zeros.

Result count

6 Bytes. Byte 26 to 31. The total (decimal) number of results in the file (equals the length of the data part of the file divided by the length of each result).
The number is prefixed with zeros.

> NOTICE: Pilot data from 1 pilot sample may add 1,2 or 3 results (value, deviation and mean) to the file - depending on system setup, so don’t assume that the number of results in the file equals the batch-total.

Internal batch file name

20 bytes, Bytes 80 to 99. The name of the file is right adjusted and prefixed with space characters.
Example:” 23378221.BAT”

Batch information

Batch information is placed from byte 128. The batch information is presented as a list of CS83/2 components:

#63/	Batch name	
#64/	Batch date	
#65/	Batch total	(Number of normal samples)
#60/	Extension 1	(user register)
#61/	Extension 2	(user register)
#62/	Extension 3	(user register)
#66/	Lab date	
#67/	Lab 1	(user register)
#68/	Lab 2	(user register)

Example of CS83/2 file header :

```
S4000-2.0   !!0126!!0098!!000001!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!          25223.BAT!!!!!!!!!!!!!!!!!!!!!!!!!!!#63/
25223#64/  01.09.99#65/      3453#60/         #61/         #62/         #66/  01.09.99#67/         #68/
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

Edit files (.EDI)

The Edit file format is equal to the Batch File format except for the following difference :

Edit File Descriptor Block

The internal Batch File name is a 20 bytes ASCII representation, right-adjusted, prefixed with spaces, 82d to 101d (52H to 65H) (including Cr+LF at position 70d).

Example : "   batch1**.EDI**"

All files in Edit file format will have the **.EDI** extension regardless of the filename convention being used for the actual DOS-filename.

CR+LF characters are inserted at the following positions in the file header

70,   (+70)

128,   (+58)

198,   (+70)

268,   (+70)

338,   (+70)

384.   (+46)

Edit File result data block

(Bytes 396 (including inserted CR+LF in header) to End of file).

> Notice:
>
> CR+LF characters are inserted for every 70th position in a result, **and** at the end of each result.

This makes the Edit file format suitable for Viewers, Editors, and Word-processors.

Edit File Descriptor block, Byte 0 to 395
Edit File Result Data block Starting at byte 396

Example of EDI file: Batch 25223, 1 result:

```
S4000-2.0   !!0126!!0098!!000001!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!          25223.EDI!!!!!!!!!!!!!!!!!!!!!!!!!!!!
#63/     25223#64/  01.09.99#65/      3453#60/         #61/
#62/          #66/  01.09.99#67/         #68/         !!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
#FF/AAA       #F0/         1#F3/         1#00/      6.56#01/     19.09
#E1/  09:15:19#E2/
```

CSV Files (.CSV)

The System 4000 CSV format makes it possible to import data directly from System 4000 into any spreadsheet program that accepts CSV data. CSV means *Comma Separated Values*.

The first lines in a CSV file contains batch-related data (batch name, total etc..). Then comes a header-line that lists the components in the batch.

The components are listed in the same order as they are defined in the Measure-setup. Two extra components are always added:

Result type: Displays the type of the result. (Normal, Carry over, Repeatability Linearisation etc..).

Bottle type: Displays the type of the bottle (Normal, Pilot 1, Pilot 2 or Pilot 3).

The rest of the CSV file consists of the results in the batch.

Note:
Using the CSV format it is possible to export Test-batches from System 4000.
(Test batches are all batch types used to test or calibrate System 4000, or in other words:
Anything except normal batches and manual/local samples).

Example of CSV batch DEMO file with two results:

Batch,DEMO,
Batch Date,17.10.94,
Total,2,
Lab Date,17.10.94,
Lab 1,,
Lab 2,,
Ext 1,,
Ext 2,,
Ext 3,,
Batch Type, Normal,
Program, FE Measure setup 2 (MSC+ID),
Pos., No., Sample Id., Fat B, Protein, Lactose, Remark, Result Type, Bottle Type,
1,1,,3.42,4.55,2.45,,Normal,Normal,
2,2,,3.49,4.21,3.11,,Normal,Normal,

Special CSV Files

It is possible to generate CSV-files containing Zero deviation values, Pilot results (pilot value and pilot deviation), Slop/Intercept changes and log data.

Filename for zero-listing is always : **_ZERO_.CSV**

Filename for pilot-listing is always : **_PILOT_.CSV**

Filename for S/I listing is always : **_SI_.CSV**

Filename for log data listing is always : **_LOG_.CSV**

Filename for manual listing is always : **_MANUAL_.CSV**

Special Cases

In case of a Critical Warning (BSC) the result may be followed by a “*” (2A Hex).

Critical Warnings are a certain group of warnings where the result may be incorrect due to the warning reported. In set-up it is decided if such results should be reported or not. If the result is not reported a “*” is shown instead. Otherwise the result is reported followed by a “*”.

In case of errors, a “*” is reported.

In case empty samples, nothing is reported. (Just 2 comma delimiters following each other).

3. Using CS83/2 for online communication

This chapter is relevant for users of Serial or TCP/IP based online communication.

Wrapping the data: The Data Frame

When using online communication, byte count and checksum must be added around the data to be transmitted enabling the receiver of the data to determine if all the bytes in a transmission was received without error. This is the purpose of the Data Frame.

The Data Frame consists of

Byte(s)	Description
(, [	Starting bracket (1 byte). Square bracket "[" is used when transmitting from System 4000 to Host, and round bracket "(" is used when transmitting from Host to System 4000.
Count, 4 bytes	Count. (4 bytes) The count bytes contain the ASCII HEX representation of the total number of bytes in the data kernel. The count is right adjusted and unused bytes are set to '0' (30 hex). Example: 0056 means 86 bytes. Appendix A contains an example showing calculation of count/check sum.
Command byte	The Command byte describes the type of the data being transmitted.
Status byte	The second byte in the message is the status byte. The status byte contains a code describing the source of the message. Normally all messages from System 4000 to host will have the status byte set to '@' (40 Hex).
Data, X bytes.	The actual data
Checksum, 2 bytes	The checksum bytes contain the ASCII HEX representation of the modulus-256 check sum of (count + data kernel). (If the check sum value is less than 10 hex, the first check sum byte is set to '0' (30 hex)). Appendix A contains an example showing calculation of count/check sum.
),]	Ending bracket (1 byte). Square bracket "]" is used when transmitting from System 4000 to Host, and round bracket ")" is used when transmitting from Host to System 4000.
Termination character(s)	See description below.

Termination Characters

Serial Transmission:

In S4000 set-up the following termination characters may be selected: No termination, CR, CR+LF.

TCP/IP Transmission:

TCP/IP messages to and from S4000 must always be terminated with a NULL character (00 Hex).

The Command Byte

All the individual commands are described in the following chapter.

Each command byte identifies a special message type as shown in the table below.

Some commands are used for data collection (Direction System 4000 to Host), others for remote control (Host to System 4000).

Command byte	Message type	Direction
1 (31 Hex)	Host ready	Host to System 4000
2 (32 Hex)	Host not ready	Host to System 4000
3 (33 Hex)	System 4000 ready	System 4000 to host
4 (34 Hex)	System 4000 not ready	System 4000 to host
5 (35 Hex)	Mode messages	System 4000 to host
6 (36 Hex)	Error messages	System 4000 to host
7 (37 Hex)	Warning messages	System 4000 to host
8 (38 Hex)	Remote control	Both ways
9 (39 Hex)	Batch- and result-data	System 4000 to host
: (3A Hex)	“No comment”	System 4000 to host
A (41 Hex)	External conveyor messages	Both ways

4. The CS83 Commands

The Host Connection Command (1,2)

Command byte=1 The host is ready.

Command byte=2 The host is NOT ready. This messages may be issued from the host in case host communication for some reason is not available.

System 4000 Connection Command (3)

Command byte=3.

The “Ready” Message

If the host is connected as “active unit”, System 4000 will send a “Ready-message to the host.

0000 S4000 Host line ready

This indicates that the System 4000 host line is reset and ready and happens :

a) During system start-up (with host ON in active units set-up).
b) During software-reset (with host ON in active units set-up).
c) When host is switched from OFF to ON in active units set-up.
d) When “host online connection” is switched from OFF to ON.

The “Paused” Message

If host is connected in Active Units and “Host online connection” is switched from ON to OFF, System 4000 will send a “Pause-message to Host.

0001 S4000 Host line paused

- indicating that host ONLINE transmission has been switched off.

The “Remote Disabled” Message

If remote control from host has been disabled by host or operator and the host is sending a remote control command, System 4000 will reply with a “Remote disabled” message, and the command will not be executed. Format:

0002 S4000 Remote disabled

The “Remote not selected” message

If host is sending a remote control command that has not been selected for remote control in set-up, System 4000 will reply with a “Remote not selected” message.

Example: Accept/Reject has not been selected for remote control (host set-up) and host sends an “Accept” remote command.

Format:

0003 S4000 Remote not selected

The ‘No Connection’ Command (4)

Command byte=4.

This message is sent to the host in case the host is trying to communicate with System 4000 and the host line has been switched (logically) off in the active units set-up. (SHIFT+F7)

Mode Message Command (5)

Command byte=5.

Mode messages are sent to host to inform the host about the current state/mode of the System 4000 system. The mode message may be one of the following :

0000 S4000 Auto

0100 S4000 Manual

0200 S4000 Standby

0300 S4000 Stop

0D00 S4000 Transition

“Transition” means that the system is changing mode (for example Stop -> Standby). The format of the mode messages are as follows:

- Byte 0,1 contains the mode as stated above.
- Byte 2,3 contains an error code.
- Byte 4 is always a space character.

The rest of the message contains text stating the mode and any fault connected to the mode-change (if error code is different from 00).

The possible error codes are:

Code	Error Text	Meaning
00	“”	No error, mode change was OK.
01	“Fault: Unknown batch name”	The batch name specified in an auto command does not exist in batch list.
02	“Fault: Illegal numerator”	The numerator specified in an auto command is outside batch limits.
03	“Fault: Wrong mode”	The requested mode change is illegal (e.g. stop to auto), or system is already in the mode that is requested.
04	“Fault: Mode is not host controlled”	System is not in “remote control from host” mode.
05	“Fault: Mode is locked”	System mode is locked (see User's Guide).
06	“Fault: System is rewinding”	System cannot change mode during a rewind operation.
07	“Fault: Errors are present”	The system has reported one or several errors and cannot change to auto mode before these errors have been corrected.
08	“Fault: Internal error”	Internal system error.
09	"Syntax error or data not complete"	The format of the mode command is wrong or data are missing.

Mode Example

Mode Example:

System is in standby.

Host commands system to auto-append (auto mode) with batch name 1234.

This batch does not exist in batch list.

The mode answer message back to host will look like this:

0201 S4000 Standby Fault: Unknown batch name

02 = Standby (system remains in standby since the auto command could not be executed).
01 = Error code (Unknown batch name).

Error Message Command (6)

Command byte=6.

Error-messages from System 4000 all have the form “+xxxx” or “-xxxx”

where xxxx is the error number.

A “+” sign indicates that the error is reported.

A “-” sign indicates that the error-condition is no longer present.

Warning Message Command (7)

Command byte=7.

Warning-messages from System 4000 all have the form “*+xxxx*” or “*-xxxx*”

where xxxx is the warning-number.

A “+” sign indicates that the warning is reported.

A “-” sign indicates that the warning-condition is no longer present.

Ordinary messages are NOT transmitted to host.

Remote Control Command (8)

Command byte=8.

Remote Control from Host to System 4000

Message	Meaning
00	Mode request
03	Auto Continue
03#63/xxxxxxxxxx	Auto Append (batch name)
03#63/xxxxxxxxxx#F0/yyyyyyyyy#F3/zzzzzzzzzz	Auto Force (batch name, position, numerator)
05	Standby
06	Stop
07 text	Message to operator
09	Enable remote control. (Host control of selected functions (see Host transmission setup)).
0A	Disable remote control. (Full operator control). ("Message to operator" and "mode-request" commands are always legal)
0D	Accept. (Zero setting accept)
0E	Reject. (Zero setting reject)
0F	Start zero-setting.
10#63/xxxxxxxxxx#64/yyyyyyyyyy #65/zzzzzzzzzz	Batch download. (Batch name, batch date, batch total). (+optional registers)
11	Reserved (Z-Auto)

Remote Control from System 4000 to the Host

Message	Meaning
00 Host please accept or reject	Host is requested to accept or reject a zero-setting using the Accept or Reject command stated above.
01xx Start zero answer	System 4000 reports if it was able to start requested zero-setting or not. (xx=error code)
02xx Batch download answer	System 4000 reports if downloaded batch data was OK. (xx=error code)
03xx	Reserved (Z-Auto)
07 text	Message from System 4000 (operator- or system message).

Remote Control: S4000 Mode

When a mode command is sent to System 4000, the host must wait for mode answer from System 4000 before proceeding with more mode commands.

It is only possible to change mode one step at a time, from Stop to Standby and then from Standby to Auto. Direct change from Stop to Auto, or from Auto to Stop is not possible. System 4000 will reply with a mode-answer described in paragraph 5.4, Mode Message Command (5).

It is possible to obtain the current System 4000 mode by using the Mode Request command (00).

The Auto Mode Functions

In previous analysers/combi-systems the auto command was a simple command. With System 4000, the Auto Mode Functions command is a powerful command giving the host control of the sample flow sequence.

Auto Continue

If no additional data is supplied, System 4000 will start analysing using the currently selected batch. (Equal to the “old” auto command).

Auto Append

When only batch name **(#63/xxxxxxxxxx**) is supplied, System 4000 will append the following results to the batch specified.

The format of the Auto Append command is :

03#63/xxxxxxxxxx

- where xxxxxxxxxx is the batch name.

(Standard CS83 component (10 characters right-adjusted)).

Note:
If the specified batch is full (batch total has been reached) the system will continue with the next batch in the batch list.

Auto Force

When batch name, position and numerator are supplied, System 4000 will place the following samples from the specific position and numerator in the given batch.

The tailer format of the Auto force command is :

03#63/xxxxxxxxxx#F0/yyyyyyyyyy#F3/zzzzzzzzzz

- where xxxxxxxxxx is the batch name.

yyyyyyyyyy is the position. (1-32000)

zzzzzzzzzz is the numerator. (1-32000)

All the components are standard CS83 components (10 characters right-adjusted).

The Auto Force command is to be used for retest of samples or other purposes that requires reference to specific samples within a batch, and requires that the specified batch, position and numerator already exists in the result list.

Remote Control: Message to Operator

The host may send a message to the System 4000 operator. The maximum length of the message is 200 characters. It is legal to send messages to operator even if host remote control is OFF.

Remote Control: Enable/Disable Remote Control

Only functions which are enabled for remote control at System 4000 can be remote controlled from the host. With "**enable remote control**" functions enabled in System 4000 (Host transmission set-up) can be remote controlled. With "**disable remote control**" full control is transferred to System 4000 operator.

If the host attempts to remote control a function that has not been set-up for remote control, System 4000 replies with a "Remote not selected" message. (See Command=3 connection messages).

If remote control has been disabled (full operator control) and host attempts to remote control a function, System 4000 replies with a "Remote disabled" message. (See Command=3 connection messages).

Remote Control: Accept/Reject Commands

If remote zero accept/reject is enabled in the System 4000 host transmission set-up, the host must :

1) Wait for the zero-setting result and check the values.
2) Wait for the remote command requesting host to accept or reject the zero-setting (tailer 00 (System 4000 to host)).
3) Send an accept (0D) or a reject (0E) back to System 4000.

Otherwise the accept/reject is done at the System 4000 keyboard.

Remote Control: Start Zero-setting, Zero-setting Reply

The host can initiate a Zero-setting with this command. The command is only valid in standby-mode.

System 4000 will send a reply back to host stating if System 4000 was able to start the requested Zero-setting or not. The reply will be one of the following :

0100 Zero-setting started
0101 Fault: Wrong mode
0102 Fault: Mode is locked
0103 Fault: MSC is not active
0104 Fault: Internal error

The format of the reply is as follows:

Byte 0,1 contains the code for Zero-check answer ("01").

Byte 2,3 contains an error code.

Byte 4 is always a space character.

The rest of the message contains text stating any fault connected to starting the requested Zero-setting.

The possible error codes are:

Code	Error Text	Meaning
00	"Zero-setting started"	No error, Zero-check is started.
01	"Fault: Wrong mode"	Zero-check cannot be started in the current mode. (System must be in standby !).
02	"Fault: Mode is locked"	System mode is locked. (See User's Guide).
03	"Fault: MSC is not active"	MSC is not selected in active units.
04	"Fault: Internal error"	Internal system error.

Remote Control: Batch Download

Batch data are sent from the host computer placed in CS83 components. These are:

#63/ Batch name

#64/ Batch date

#65/ Total

#66/ Lab date

#67/ Lab1

#68/ Lab2

#60/ Ext1

#61/ Ext2

#62/ Ext3

Batch name, batch date and total must always be included in a batch download message from host. The rest are optional (all components for a batch must be sent in the same message).

If the Lab and Ext components are not downloaded from host, the Ext and Lab data from the previous batch in the System 4000 batch list will be copied to the new (downloaded) batch.

The date-month-year format for Batch date and Lab date may be set-up to fit local standards.

This set-up is made in the System Manager program (menu item *International*, sub-menu item *Date Format*).

The format specified here is the data format the System 4000 expects when keying-in or downloading batch data, and also the format returned to host as part of batch/result data.

In the message, the batch components must be preceded with the ASCII number **10** which is the hex code for batch download data. Example:

10#63/ 19686#64/ 24.06.94#65/ 134

(batch 19686, date 24/6/94, total 134).

To receive batch data from host the System 4000 must be in "Remote control".

Batch data may be downloaded in all modes except during reset.

If the operator has entered the batch input dialogue to key-in batch data, and a batch download message from the host is received, the batch data from host will be ignored (an error code is returned to host).

Every new batch will be appended at the end of the batch list.

Batch data downloaded from host will be assigned to the default measure set-up program selected in System 4000 at the time when the batch is downloaded. The batch type will always be “Normal”. (The operator may alter measure set-up program and batch type after the batch has been appended to the batch list).

System 4000 will send a reply back to host stating if the batch download was OK. The reply will be one from the following list:

0200 No error

0201 Wrong mode

0202 Not host controlled

0203 Batch dialogue shown

0204 Batch name conflict

0205 Wrong total

0206 Date conflict

0207 Program error

0208 Internal error

0209 Data not complete

The format of the reply is as follows:

- Byte 0,1 contains the code for Batch download-answer (“02”).
- Byte 2,3 contains the error code.
- Byte 4 is always a space character.
- The rest of the message contains text stating any fault related to the batch download.

Description of error codes:

Error	Description
00 No error	The batch data was OK.
01 Wrong mode	Batch data was received during reset. Data are not stored.
02 Not host controlled	System 4000 is not in remote control mode.
03 Batch dialogue shown	Operator is keying-in batch data. Data from host are not stored.
04 Batch name conflict	Batch name is invalid or batch already exists in batch list
05 Wrong total	Batch total is invalid
06 Date conflict	Lab date < batch date
07 Program error	Default program error (internal error in System 4000 makes it impossible to select default program)
08 Internal error	Internal data conflict
09 Data not complete	Data (Batch name, batch total or batch date) are not complete, or the format is wrong

Batch- and Result-data Command (9)

Command byte = 9. Tailer is used.

Batch and result data are constructed as sets of CS83 components. (Please refer to appendix B).

'No comment' command (:)

Command byte = :

This command/message is sent to host in case host initiates the protocol and System 4000 has no data to be transmitted.

External Conveyor Command (A)

Command byte = A.

System 4000 is able to interface to an external conveyor. This is done using the messages below. The messages for the conveyor control may be sent on the host serial line (mixed with the normal host messages), or a separate serial line used only for the external conveyor. This is decided in Setup (Select 'S4000 / Windows / Setup / conveyor-pipette')

External conveyor commands, CS83 Status byte = "Q":

Remote Control to External conveyor from System 4000:

Data byte 1	Meaning
N	Next Sample. (System 4000 request for next sample)
3	Auto
5	Standby
6	Stop

Remote Control from Auxiliary. Conveyor to System 4000

Data byte 1	Meaning
S	(Stirrer) Sample at stirrer position.
P	(Pipette) Sample at pipette position
B	(Both)Sample at pipette + stirrer position
W	(Wait) no sample for the next xx sec
E	Error.

Data byte 2	Meaning
0	Normal sample at pipette position
1	Pilot 1 at pipette position
2	Pilot 2 at pipette position
3	Pilot 3 at pipette position

Data byte 3	Meaning
0	No ID reader
1	ID OK
2	ID read error

Data byte 4 – 25	Meaning
xxxxxxxx	Barcode ID

External Conveyor Example

Standby -> Auto, Measuring samples, Auto -> Standby.

System 4000	Direction	External conveyor
AQ3, Auto	-------->	Get ready for auto mode
	<--------	**5Q00**, conveyor auto. (Optional)
AQN, Next	-------->	Get sample to stirrer position.
	<--------	**AQW**, send wait command if it takes more than xx sec.
Stir the sample	<--------	**AQS**, sample is at stirrer position
AQN, Next	-------->	Get sample to pipette position
Take in sample	<--------	**AQB00{.id.}** Normal sample at pipette & stirrer positions.
AQN, Next	-------->	Get next stirred sample to pipette position
Take in sample	<--------	**AQB20**{.id.} Pilot 2 at pipette & sample at stirrer position.
AQN, Next	-------->	Get next stirred sample to pipette position
Take in sample	<--------	**AQP00{.id.}** Normal sample at pipette position and no sample at stirrer position
AQN, Next	-------->	Get next sample to stirrer position
Continues processing Samples already taken in	<--------	**AQW** Send wait if no samples for the next 8 sec.
Stir sample	<--------	**AQS** sample at stirrer position
AQN, Next	-------->	Get sample to pipette position
Take in sample	<--------	**AQB00{.id.}** Normal sample at pipette & at stirrer position.
AQN, Next	-------->	Get sample to pipette position
	<--------	**AQE** Error occurred in the conveyor
8Q5, Standby	-------->	
	<--------	**5Q02** Standby. (optional).

External Pipette Command (E)

Command byte=E

System 4000 is able to interface to an external pipette. This is done using the messages below.

The messages for the pipette control may be sent on the Host serial line (mixed with the normal host messages) , or a separate serial line used only for External conveyor/pipette.

This is decided in Setup (Select 'S4000 / Windows / Setup / conveyor-pipette')

External pipette commands, CS83 Status byte = "Q":

Remote Control to External Pipette from System 4000

Data byte 1	Meaning
S	Stirrer. Move stirrer into sample, stir and raise stirrer to top position, report back (U = Up answer)
P	Pipette. Move pipette into sample, report back. (D = Down answer).
B	Both. Move pipette & stirrer into sample(s), report back. (D = Down answer).
E	End. Raise pipette and stirrer to top position, report back. (U = Up answer).
L	Liquid request. Report liquid status at pipette. (A = Liquid answer).
T	Stir. Stir sample (used when 2 or more suctions in each bottle are required).

Remote Control from External pipette to System 4000

Data bytes	Meaning	Data description
Ax	Answer	x=0: No liquid
		x=1: Liquid at pipette
Dessssttt	Down answer	e=0: Movement OK
		e=1: Movement fail
		ssss: Suck volume
		tttt: Total volume
Ue	Up answer	e=0: Movement OK.
		e=1: Movement fail.

NOTICE:

Pipette volumes in 1/10 ml, represented in ASCII hex, with LSB in 2 first bytes and MSB in the 2 last bytes. (e.g. 6 ml = 60 = 3C00 ASCII)

5. The CS83/2 Serial Protocol

This chapter is relevant when using serial transmission with protocol for optimal security. It is also possible to use serial transmission without protocol.
(The protocol is unchanged compared to Standard CS83)

Description of the Protocol characters

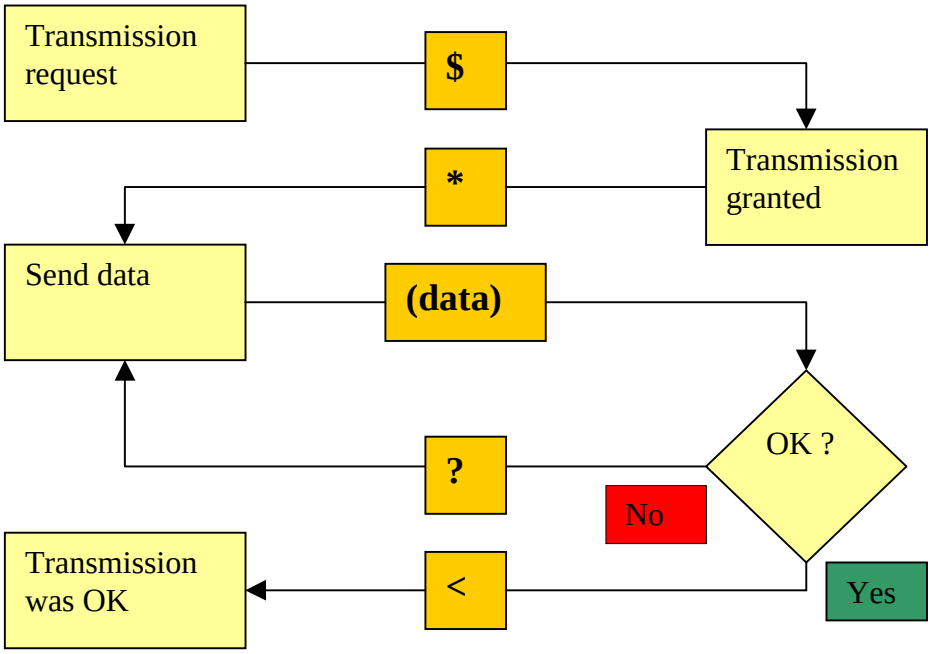
Protocol characters are all readable ASCII characters.

Protocol character (ASCII)	Direction	Meaning
$	To System 4000	The host wishes to start a transmission
*	To Host	System 4000 is ready for transmission
(data)	To System 4000	Data from the host to System 4000.
<	To Host	Data were accepted.
?	To Host	Data not accepted.
&	To System 4000	Data requested. Used when the host requests data from System 4000
[data]	To Host	Data from System 4000 to the host
>	To System 4000	Data accepted.
%	To System 4000	Data NOT accepted. System 4000 will re-transmit [data frame]. (Max. 2 re-transmissions). If System 4000 is unable to transmit data after having tried 3 times, an error message is displayed
!	To Host	System 4000 requests the host to start-up transmission protocol. If host communication is enabled when System 4000 is activated, this signal will also be transmitted every 5 seconds in an attempt to establish communication with the host. This also happens in cases where the communication with the host for some reason has been cut off, e.g. because a transmission line has been down, and in other cases when System 4000 detects that the host for some reason is not responding

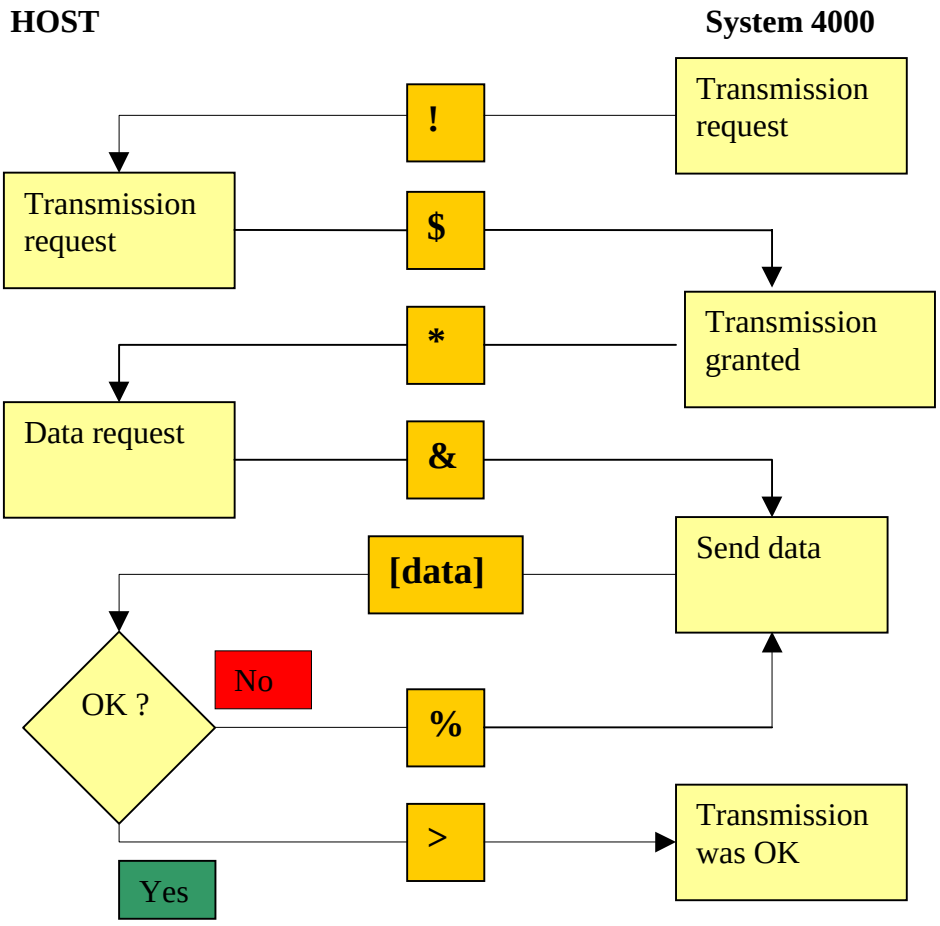
Protocol flowcharts

Transmission from Host to System 4000:

HOST **System 4000**



Transmission from System 4000 to Host:



Description of the Protocol Seen from the Host Computer

When the protocol is started, the counter for communication attempts is set at zero. Then "$" is sent. If "*" is not received within a time-out (3 seconds) "$" is sent again. This is done for a total of 3 times before giving up. When "*" is received a data post will be either **transmitted** or **received**.

Transmitting:

- "(*data frame*)" is sent and the host waits for a reply (time-out 3 seconds).
- If the reply is "<" everything is OK and the data has been transmitted.
- If the reply is "?" there has been a transmission error and the host tries again (max 2 retries).
- If any other character is received the transmission will be accepted.
- If there is no reply at all, the host will have time-out (3 seconds) and the data will not be re-transmitted.

Receiving:

- A “&” is sent and the host waits for reception of “[*data frame*]” (time-out 3 seconds).
- If [*data frame*] is received, a “>” is sent and the transmission was OK.
- If [*data frame*] is not received satisfactorily, the host waits until System 4000 is expected to be finished (time-out 3 seconds). The host then sends “%” and waits for re-transmission of “[*data frame*]”.
- If “]” is not received at all, the protocol is initiated using “$” and “*”, and a new reception attempt is started. This procedure is also carried out maximum 3 times.

6. Selecting Data Interface Method

This paragraph describes the various data interfaces that the System 4000 Software offers.

Supported Output Devices

The System 4000 can present data on five output devices.

Data can be obtained during analysis (online to hosts and printer) or after analysis (export).

- TCP/IP host (online+export)
- Serial host (RS232 line) (online+export)
- Floppy disk (export)
- Network drive (export)
- Printer (online+export)

Export of data is initiated by the operator one or several times during a work session. A selected block of results may also be exported at any time.

Sorting Data

The main difference between online data and exported data lies in the sorting of results. Before any data are exported, the System 4000 will sort the data so that any re-tested sample results will replace the original result for that sample. This makes it easier to process the data, since the program which is processing the data does not have to deal with re-tested samples.

It is possible to export unsorted data.

Overview of Interface Methods

	Online data from System 4000	Exported data from System 4000
Host (Serial or TCP/IP)	The online host interface is the most advanced. It offers immediate access to result data and even the possibility of interacting with the System 4000 Each result is sent to host as soon as it is measured. In case of batch-change, batch data will be sent prior to the first result in the batch. A lot of additional data (error messages, status messages etc.) may also be sent to the host during analysis. The host computer can remote control some features in System 4000	Data are sorted and hereafter sent to host result by result until all results have been sent. Batch data are sent prior to first result in the batch.
Disk	Data cannot be recorded on disk online.	Data are sorted and hereafter written into separate batch-files on the floppy disk or the network drive. Data may be exported in several formats: CS83 BAT/EDI files or CSV files which are suitable for import in spread-sheets, data bases etc. It is possible to export CSV files containing all result data, or special lists containing zero-values, pilot values, S/I values, raw data, and/or log data for the work session.
Printer	The system collects results for one page (results per page is selectable in the set-up program). When all results for a page are collected - the page will be printed.	Results are sorted. Hereafter all selected batches are printed.

7. Using the System 4000 Host Interface

The following host interface specifications cover both serial host (RS232) and TCP/IP host.

It is possible to connect System 4000 to a network using the TCP/IP protocol in order to transmit data online to a remote server or host on the network. The TCP/IP host offers the same features as the serial-host regarding remote control and data-types. The data format used is CS83/2. Since the TCP/IP protocol handles the synchronisation, only the DATA KERNEL of the CS83/2 specification is used when running against a TCP/IP host.

Serial Host Setup

Using the SETUP-APPLICATION (Select 'S4000 / Windows / Setup / Data interface / host serial'), the following transmission parameters may be set:

- Baud rate
- Data bits
- Stop bits
- Parity
- Termination
- Delay

The hardware connection is described in Appendix C.

Using serial host it is possible to choose between Simple and Full CS83 protocol.

In Simple CS83 transmission the CS83 protocol is omitted. Each result is simply transmitted as a string of characters - the host does not have to answer back. This also means that re-transmissions cannot be ordered from the host computer.

The simple CS83 is recommended for trial and test only since transmission security is lower than with the Full CS83 protocol.

TCP/IP Host Setup

Using the set-up application (Select 'S4000 / Windows /Setup / Data interface / host TCP/IP'), it is possible to set remote host and service names for 2 TCP/IP connections. This makes it possible to deliver online data to two different remote host stations at the same time.

> IMPORTANT:
>
> Note that the Host and Service names used must be defined in the HOSTS and SERVICES files in the C:\WINDOWS directory on the analyser. Also note that TCP/IP protocol drivers and network interface cards must be installed on the PC.

Enabling Host Input/Output

To enable the host-interface, host must be switched **ON** in the **Active units set-up**.

(Select 'F7' function key).

Host Output Mode

There are two basic concepts for using the host output :

- **ONLINE MODE** where data are transmitted to the host as soon as they are generated by the system.
- **EXPORT MODE** where data are sent to host AFTER the analysis has taken place, for example at the end of every workday or work-session.

The switch between these modes is set in the “Host Online” option. (Select ‘SHIFT+F7’).

Export mode

Export mode is the simplest way to obtain data to host. Data from a days work (or less) are sorted, arranged in correct sequence and thereafter transmitted to host. (Export is initiated by the operator).

Online mode, programming considerations

When online host transmission is used, the host will receive results as soon as they are generated. The ONLINE concept is more complex since a result for a sample may occur several times due to re-test, correction of sample-id, editing result-labels etc. The same problem relates to batch-data.

The POSITION of a result will always be unique and may therefore be used as an identifier/index for the given result. (It is possible to overrule/change the position-value, but this would normally not occur).

The sequence rules of batch/result-data are as follows:

- A batch header is always transmitted when changing from one batch to another. This also applies to re-test and other error-handling features.
- A given result may occur several times due to re-test, etc.

Host Online Data Sequence Example

Consider the following analysis sequence:

BATCH A
result 1
result 2
result 3
result 4
result 5
BATCH B
result 6
result 7
result 8
RETEST of result 4
RETEST of result 5
RETEST of result 6
result 9
result 10

On the host line this sequence would appear as :

BATCH A
result 1
result 2
result 3
result 4
result 5
BATCH B
result 6
result 7
result 8
BATCH A
RETEST result 4
RETEST result 5
BATCH B
RETEST result 6
result 9

result 10

Note that “extra” batch-headers have been inserted to indicate to which batch the following results belong. (As in the result list on the monitor).

In Online mode the following data types may be passed to host :

- **Normal results/Batch data**
- **Pilot results**
- **Other result types** (Note: All zero deviation results including manually activated zero-settings will be transmitted)
- **Modes** (Stop, Standby, Auto etc.)
- **Errors** (Error messages from the analysers)
- **Warnings** (Warnings from the analysers)

If the CS83 Result Type component is used, *all* result types may be passed to host.

This is decided in Setup (Select ‘S4000 / Windows / Setup / Data Interface / Data Router’).

Local and Manual Results

Local and manual results are generally NOT passed to the host-computer. The only exception is zero deviation results which will always be passed on to host (if selected in set-up).

Appendix A, CS83/2 Dataframe Example

CS83 Count/Checksum Calculation

Transmitting a FatB result -0.03, the CS83/2 message would look like this:

"9@#01/- 0.03" Command=9, Status=@ (Data)

"**0010**9@#01/-0.03**75**" Count=**0010**H, Check sum=**75**H. (Frame+data)

Data byte	Count	Checksum		Remark
0	-	30H	Sum = 375H. Checksum = 375H modulus FF = **75H**.	Count (MSB)
0	-	30H		
1	-	31H		Count (LSB)
0	-	30H		
9	1	39H		Command byte, start of data
@	2	40H		Status byte
#	3	23H		Prefix code for Fat B
0	4	30H		
1	5	31H		
/	6	2FH		
-	7	2DH		Negative value
Space	8	20H		
Space	9	20H		
Space	A	20H		
Space	B	20H		
Space	C	20H		
0	D	30H		
.	E	2EH		
0	F	30H		
3	**10**	33H		Count is **0010H**
7	-	-		Checksum MSB
5	-	-		Checksum LSB.

Appendix B, The CS83/2 Components

The Component prefix Codes

Predicted Components

Prefix	Name	Description
#00/	Fat A	
#01/	Fat B	
#02/	Protein	
#03/	Lactose	
#04/	-	Unused
#05/	FPD	Freezing Point Depression
#06/	Cells	
#07/	Casein	
#08/	Bacteria	
#09/	Urea	
#0A/	Citric Acid	
#0B/	H-Index	Homogenisation index
#0C/	G	Conductance
#50/ to #5F/	“Spares”	16 new component prefixes to be used with measured components.

Derived components

Prefix	Name	Description
#D0/	Z-value	
#D8/	Derived 1	Derived component calculated from user defined formula
#D9/	Derived 2	Derived component calculated from user defined formula
#DA/	Derived 3	Derived component calculated from user defined formula
#DD/	CFU	
#DE/	Signal Mean	
#DF/	R-value	
#10/ to #14/	Derived	Extra prefix codes to be used with user defined derived components

Batch/Laboratory Control Components

Prefix	Name	Description
#60/	Batch Extension 1	Component for user defined data
#61/	Batch Extension 2	Component for user defined data
#62/	Batch Extension 3	Component for user defined data
#63/	Batch name	Number or name identifying a batch
#64/	Batch date	Date when the samples in the batch were collected
#65/	Batch total	Number of samples (excluding eventual pilot samples) in the batch
#66/	Lab date	Analysis date
#67/	Lab Extension 1	Component for user defined lab data (typical operator name/id)
#68/	Lab Extension 2	Component for user defined lab data
#69/	Sample id	1-10 digits barcode identification
#6F/	Sample id extension	11-20 digits barcode identification. This component is only necessary if barcode data exceeds 10 characters.

Pilot ID-label Group

Prefix	Name	Description
#79/	Pilot sample id	1-10 digits barcode identification from a pilot sample
#7F/	Pilot sample id extension	11-20 digits pilot sample barcode identification

System components

Prefix	Name	Description
#E0/	Date	Format is YY/MM/DD prefixed with spaces
#E1/	Time	Format is HH:MM:SS
#E2/	System Remark	Used by the system to report system events for the result (for example Rejected or Acpeted for zerosetting results.
#E3/	Operator Remark	Used by the operator to report special information related to a specific sample. (max 10 characters)
#E4/	Result Label	Letters A-J indicates active labels, Ex. “#E4/ ABEH” indicates that user labels A,B,E,H are active for the result in question. See description in reference manual.
#F0/	Position number	A counter which starts at 1 in the beginning of a worksession and increments for each new sample measured in automode.
#F3/	Numerator	A counter which is reset to 1 whenever a new batch starts.
#F9/	Sub-numerator	The sub-numerator enumerates the number of intakes from the same bottle, for example in a repeatability batch.
#FF/	Result Type	Indicates the type of a result. Please refer to description elsewhere in this manual.

Appendix C, Updating from standard CS83 to CS83/2

Please notice the following changes when upgrading from CS83 to CS83/2:

Item	Standard CS83	CS83/2
Pilot type	Pilot type is represented in byte 6 of each measured component in a pilot result (only pilot 2+3)	Pilot type is represented in the type component.
Component prefixes	Component prefixes first digit was used to represent result types.	The type of a result is now represented in the Result Type component. New prefixes available.
Empty bottle, online transmission	In case of empty results the component #F7/ was appended to the result.	Empty bottle is now represented in the Result Type component.
Result type component	A limited number of Result types (Zero, Pilot mean, deviation, value) could be represented using the first prefix byte in each measured component. Result Type component was from System 4000 Software version 3.0 available as an alternative.	CS83/2 is fully based on the use of Result Type component. Result types has changed because of new calibration concept.
Number of components within a single result	Limited to 15 components	CS83/2 can handle several hundred components within a single result. In real life it should be safe to use an input buffer of 1000 bytes (making room for 70 components). Make sure that your data handling system can handle the larger amount of data.

Derived components	Fixed derived components (Fat AB, SnF TS etc)	New concept with user defined formula for calculation of up to 3 derived components in a measure program.

CS83/2 Data file specific changes

The following part of this table contains information only relevant when using CS83/2 data files (.BAT and .EDI files)

Item	Standard CS83	CS83/2
File header (first 384 bytes in each datafile)	-	Several changes from CS83 to CS83/2, please refer to the File header description elsewhere in this manual.
Data file compatibility	DaCo2 / DaCo-SA compatible	Not DaCo2 / DaCo-SA compatible

Appendix D, Hardware Connection

The System 4000 host output port is a 25 pole male plug (sub connector, Cannon DB25-S or similar). Pins 2,3 and 7 are adequate for RS232-C data.

- System 4000 Pin 1 is FRAME GROUND
- System 4000 Pin 2 is TRANSMIT
- System 4000 Pin 3 is RECEIVE
- System 4000 Pin 7 is SIGNAL GROUND