6.6 Communication Interface

6.6.1 Outline of Communication Interface

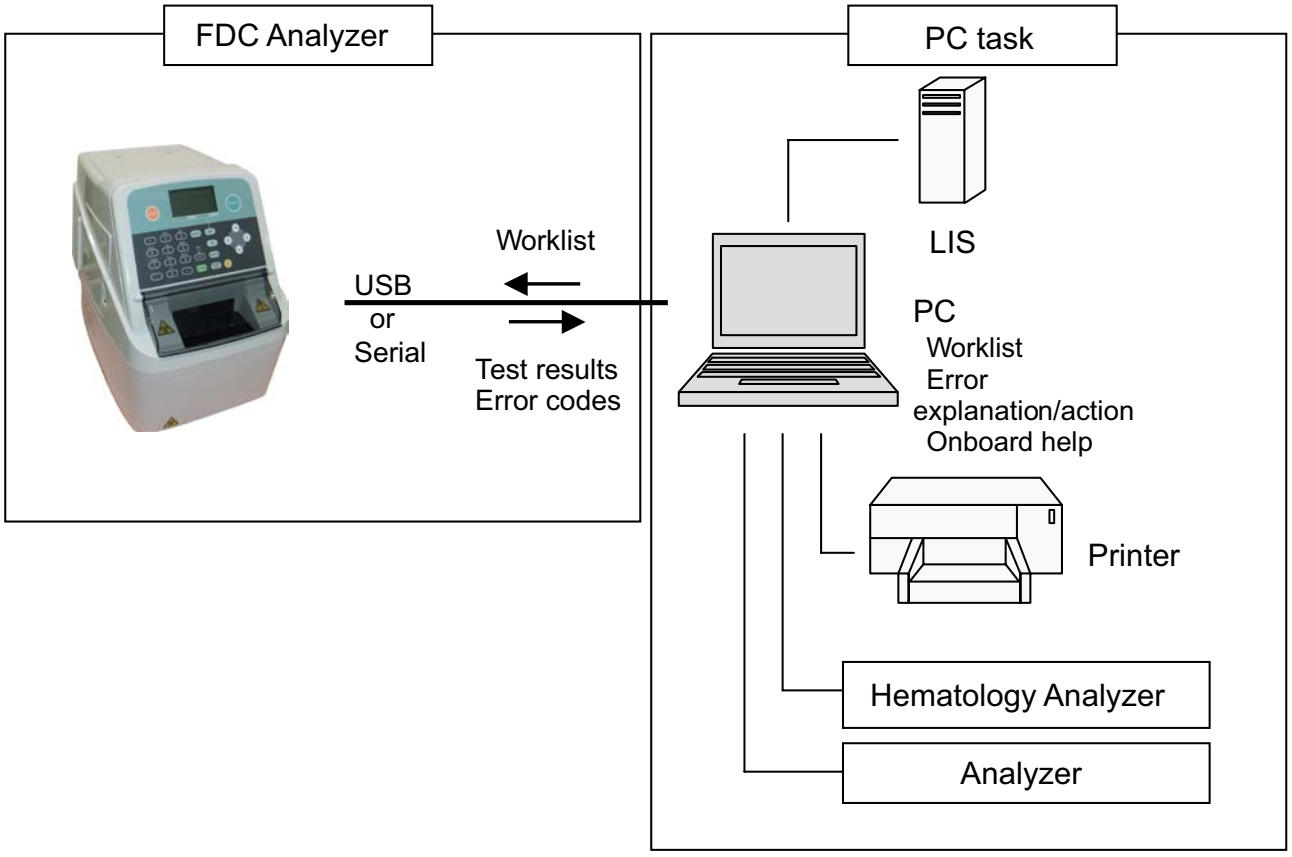
Communication interface has 3 types as following. The protocols of Type 1 and Type 2 are different from those of the FDC4000
All protocols are able to use either a RS-232C connector (COM1A, 9pins) or a USB connector (COM1B) alternatively.

(1) 2-way communication (requesting test information) [Type 1]
The analyzer requests test information (patient names, test names, etc.) to PC and sends test results after the measurements completed. The protocol is different from the FDC4000's Type 1 protocol.
When using this protocol, select [Type 1] in Mode 46.

(2) One-way communication (without requesting test information) [Type 2]
Type 2 is a one-way transmission of test results and its protocol is same as Type 1.
When using this protocol, select [Type 2] in Mode 46.

(3) One-way communication (conventional) [Type 3]
Type 3 is one-way transmission as same as the protocol of the FDC3500.
When using this protocol, select [Type 3] in Mode 46.

6.6.2 System Configuration



6.6.3 Interface Specifications

(1) Communication Specifications

NOTE: <USB> or <Serial (RS-232C)> is selectable by SW1 (rear panel).

<USB>

USB 2.0 Full Speed Compatible

We will use an USB-UART bridge chip to establish USB interface with PC.
The following IC will be used:
Maker: Silicon Laboratories
Model: CP2102
Home Page: http://www.silabs.com/tgwWebApp/public/index.htm
The maker's Web sites are providing the virtual com port drivers. By using this driver, the application software of PC can be developed as same method of Windows standard com port access.

<Serial>

Mode 46 Host (LIS) connection	Host connection: ON (Yes)		
Mode 46 Com type	Type 1	Type 2	Type 3
Transmission path	RS-232C interface		
Synchronizing method	Asynchronous communication method		
Data transfer rate	19200 bps (fixed)	19200 bps (fixed)	9600 bps (fixed)
Character length	8 bits (fixed)		
Stop bit	1 bit (fixed)		
Parity (VRC)	None (fixed)		
Flow control	Hardware method (CTS/RTS)		
BCC (Parity BCC)	EOR (Exclusive OR except for STX) (fixed)		None (fixed)

NOTE: The Mode 46 settings can be applied to USB interface.

(2) Control Specifications

(a) Time-out monitoring for transmission
Condition: CTS signal remains inactive for five seconds continuously.
Action: The analyzer clears the request and waits the next event (request).

(b) Time-out monitoring for receiving reply
Condition: Five seconds have passed without receiving the reply after sending the request command.
Action: The analyzer clears the request and waits the next event (request).

(c) Re-transmission
No re-transmission supported

6.6.4 Communication Data Format

(1) Communication Data System

(a) Text format

[STX (02H)], Command type, Parameter1, parameter2, … [ETX (03H)] [BCC]

The parameters are added as required.

The " , " (breakpoint) is inserted between a command type and a parameter and between parameters.

To connect some blocks, [ETB (17H)] is added at last.

Within parameter, " , " and " @ " are prohibited. Usable character codes are 20H to 7EH and A1H to DFH.

Ex.)

STX	Command type	,	Parameter 1	,	Parameter 2	ETX	BCC

Ex.)

STX	Command type	,	Parameter 1-1	,	Parameter 1-2	ETB

Parameter 2-1	,	Parameter 2-2	ETX	BCC

(b) BCC

The calculation range for BCC is from the next of STX (command type) to ETX.

The calculation method is exclusive OR.

Ex.)

STX	Command type	,	Parameter 1	,	Parameter 2	ETX	BCC

Calculation range

(2) Communication Data

(a) Command type list

Request / Info (Analyzer=>PC)		Reply (PC=>Analyzer)	
Command type	Description	Command type	Description
X	Request for Worklist index (AU10)	X	Reply for Worklist index (AU10)
S	Test start info		
R	Test results info		
E	Error info		

(b) Definition

Name	Description
Command type	Given by one alphabetical character
Sample No. *1	Assigned sample No. given by PC
Patient ID	Unique ID for a patient (e.g patient's file No.)
Patient name	Patient name
Sample type	W or P or U
Number of test	Number of tests for a sample
Test name	Requested test name
Worklist index	A set of a sample No., a patient ID, a patient name and others
Species	Unique No. assigned for species
Reception No.	No. for a patient (unique No. within a working day)

*1 Sample No.:
When PC assigns a number, the format is "yyyymmdd**" ["Year" + "Month" + "Day"+ "Number (starting 01)"]. (Ex. 2013122001)
In the off-line mode, the format is "**" [Number (starting 01)] without year, month and day.

6.6.5 Communication Data Details

(1) Request for Worklist index (for AU10)

This is used when the analyzer requests Worklist to PC.

Item	Character	Size	Description
Header	STX	1	STX: 02h
Command type	'X'	1	Request command for Worklist index ('X': 58h)
Breakpoint	','	1	
Sample No.	Numerical	13	Max. 13 characters
Breakpoint	','	1	
Patient ID	Alphabetical & numerical	13	Max. 13 characters
Breakpoint	','	1	
Patient name	Alphabetical & numerical	13	Max. 13 characters
Breakpoint	','	1	
Number of requests	Numerical	2	Maximum number of indexes to be requested 1 to 99 (Max. 2 characters)
Delimiter	ETX	1	ETX: 03h
BCC			

NOTE: Sample No. is the first key to search the Worklist. Blank data is allowable.

NOTE: The search direction is forward direction of the Worklist. But, the Worklist data which has already been informed to start the measurements will be searched last.

NOTE: The search results will be sent with the reply for the request (Worklist index).

NOTE: The search key is Sample No., Patient ID, and Patient name.

NOTE: In case that plural data exist, the order is Sample No. => Patient ID => Patient name.

NOTE: Sample No., Patient ID, and Patient name are Maximum 13 characters. Even if the data length is under 13, it is NOT necessary to fill the data area with "space".

<Ex.1> When requesting Worklist index information of 5 samples without assigning a starting ID for search:

(Transmit data)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	STX	X	,	,	,	,	5	ETX	BCC						

☐ = Space

<Ex.2>When requesting Worklist index information of 5 samples starting from sample ID "061201":

Sample No. 061201
Patient ID 12345ABCD
Patient name Tarou Fuji

(Transmit data)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	STX	X	,	0	6	1	2	0	1	,	1	2	3	4	5
2	A	B	C	D	,	T	a	r	o	u	□	F	u	j	i
	,	5	ETX	BCC											

□ = Space

(2) Reply for Worklist request (for AU10)
This is used when PC sends Worklist to the analyzer.

Item	Character	Size	Description
Header	STX	1	STX: 02h
Command type	'X'	1	Reply command for Worklist index ('X': 58h)
Breakpoint	','	1	
Number of indexes	Numerical	2	Number of following indexes (Max. 2 characters)
Breakpoint	','	1	
Sample No. 1	Numerical	13	Max. 13 characters
Breakpoint	','	1	
Patient ID 1	Alphabetical & numerical	13	Max. 13 characters
Breakpoint	','	1	
Patient name 1	Alphabetical & numerical	13	Max. 13 characters
Breakpoint	','	1	
Species 1	Numerical	2	0 to 99 (Max. 2 characters)
Breakpoint	','	1	
Sex 1	Numerical	1	0: Male, 1: Female, 9: Undefined
Breakpoint	','	1	
Age 1	Numerical	3	999: Undefined (Max. 3 characters)
Breakpoint	','	1	
Number of tests	Numerical	2	0 to 5 (number of test names) (2 characters fixed (padding by 0) : "00" to "05"
Breakpoint	','	1	
Test name 1	Alphabetical	6	Max. 6 characters
Breakpoint	','	1	
Test name 2	Alphabetical	6	Max. 6 characters
Breakpoint	','	1	
Test name 3	Alphabetical	6	Max. 6 characters
Breakpoint	','	1	
Test name 4	Alphabetical	6	Max. 6 characters
Breakpoint	','	1	
Test name 5	Alphabetical	6	Max. 6 characters
Block breakpoint	ETB	1	
...			
Sample No. n	Numerical	13	Max. 13 characters
Breakpoint	','	1	
Patient ID n	Alphabetical & numerical	13	Max. 13 characters
Breakpoint	','	1	
Patient name n	Alphabetical & numerical	13	Max. 13 characters

Breakpoint	‘,’	1	
Species n	Numerical	2	0 to 99 (Max. 2 characters)
Breakpoint	‘,’	1	
Sex n	Numerical	1	0: Male, 1: Female, 9: Undefined
Breakpoint	‘,’	1	
Age n	Numerical	3	999: Undefined (Max. 3 characters)
Breakpoint	‘,’	1	
Number of tests	Numerical	2	0 to 5 (number of test names) 2 characters fixed (padding by 0): "00" to "05"
Breakpoint	‘,’	1	
Test name 1	Alphabetical	6	Max. 6 characters
Breakpoint	‘,’	1	
Test name 2	Alphabetical	6	Max. 6 characters
Breakpoint	‘,’	1	
Test name 3	Alphabetical	6	Max. 6 characters
Breakpoint	‘,’	1	
Test name 4	Alphabetical	6	Max. 6 characters
Breakpoint	‘,’	1	
Test name 5	Alphabetical	6	Max. 6 characters
Delimiter	ETX	1	ETX: 03h
BCC			

NOTE: Sample No., Number of tests, and Number of indexes are essential.

NOTE: When no data in the Worklist, the “Number of indexes” should be 0 (zero). However, the sample No. send with the “Request for Worklist index” should be copied into the “Sample No. 1” field.

NOTE: When the Worklist has test orders, the sample No. is essential, and either the patient ID or the patient name is essential in the Worklist data.

NOTE: In case that the sample No. is blank, or both the patient ID and the patient name are blank (even if the sample No. has data), the field is invalid.

NOTE: The “Number of tests” is the number of test names, which is Max. 5.

NOTE: The “Number of tests” = “0” means there are no orders.

NOTE: If a number of the “Test name” fields is larger than the “Number of tests”, overflowed fields (larger than the number of tests) are ignored.

NOTE: If a number of the “Test name” fields is smaller than the “Number of tests”, the process will continue without error.

NOTE: The number of the “Test name” fields is Max. 5.

NOTE: If a number of index fields is larger than the “Number of indexes”, overflowed fields (larger than the number of indexes) are ignored.

NOTE: If a number of index fields is smaller than the “Number of indexes”, the process will continue without error.

NOTE: A block breakpoint (ETB) must NOT be added at the end of the last index field.

(Ex.) When replying with 2 samples data:

First sample information	Sample No.	2006061201
	Patient ID	ABCDEFGHIJKLM
	Patient name	Taro Fuji
	Species	2: Feline
	Sex	1: Female
	Age	3 years
	Number of tests	3
	Test name1	v-TSH
	Test name2	v-T4
	Test name3	v-CORT
Second sample information	Sample No.	2006061202
	Patient ID	12345ABCD
	Patient name	Lucy Smith
	Species	1: Canine
	Sex	0: Male
	Age	1 year
	Number of tests	1
	Test name1	v-TSH

(Transmit data)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	STX	X	,	2	,	2	0	0	6	0	6	1	2	0	1
2	,	A	B	C	D	E	F	G	H	I	J	K	L	M	,
3	T	A	r	o	□	F	u	J	i	,	2	,	1	,	3
4	,	3	,	v	-	T	S	H	,	v	-	T	4	,	v
5	-	C	O	R	T	ETB	2	0	0	6	0	6	1	2	0
6	2	,	1	2	3	4	5	A	B	C	D	,	L	u	c
7	y	□	S	m	i	t	h	,	1	,	0	,	1	,	1
8	,	v	-	T	S	H	ETX	BCC							

□ = Space

(3) Test start information

This is used when the analyzer sends test start information to PC.

Item	Character	Size	Description
Header	STX	1	STX: 02h
Command type	'S'	1	Test start information command('S': 53h)
Breakpoint	','	1	
Test condition	Alphabetical	7	Selecting control measurements or normal measurements: CONTROL or NORMAL□ <□ : Space (20h)>
Breakpoint	','	1	
Test date	Numerical	10	Year, month, and day when the measurements performed. (Ex. 2006-09-25)
Breakpoint	','	1	
Test time	Numerical	5	Time when the measurements performed. (Ex. 10:50)
Breakpoint	','	1	
Sample No.	Numerical	13	Unique ID for each sample
Breakpoint	','	1	
Patient ID	Alphabetical & numerical	13	Unique ID for each patient
Breakpoint	','	1	
Patient name	Alphabetical & numerical	13	Patient name
Breakpoint	','	1	
Sample position	Numerical	2	Sample position on the sample disk ('01' fixed)
Delimiter	ETX	1	ETX: 03h
BCC			

NOTE: Each data field is a fixed-length field, so that data should be embedded from the left and spaces (20h) should be embedded in the remaining field.

NOTE: The Sample position should be fixed as "01".

<Ex.> When the test for the 1st sample starts on June 12, 2006 at 10:50:

Sample No.	2006061201
Patient ID	ABCDEFGHIJKLM
Patient name	Taro Fuji

(Transmit data)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	STX	S	,	N	O	R	M	A	L	□	,	2	0	0	6
2	-	0	6	-	1	2	,	1	0	:	5	0	,	2	0
3	0	6	0	6	1	2	0	1	□	□	□	,	A	B	C
4	D	E	F	G	H	I	J	K	L	M	,	T	a	r	o
5	□	F	u	j	i	□	□	□	□	,	0	1	ETX	BCC	

□ = Space

(4) Test results information (For 2-way communication: Type 1 , Type 2)
This is used when the analyzer sends test results to PC.

Item	Character	Size	Description
Header	STX	1	STX: 02h
Command type	'R'	1	Test results inform command ('R': 52h)
Breakpoint	','	1	
Test condition	Alphabetical	7	Selecting control measurements or normal measurements (CONTROL or NORMAL□)
Breakpoint	','	1	
Test date	Numerical	10	Year, month, and day when the measurements performed. (Ex. 2006-09-25)
Breakpoint	','	1	
Test time	Numerical	5	Time when the measurements performed. (Ex. 10:50)
Breakpoint	','	1	
Sample No.	Numerical	13	Unique ID for each sample
Breakpoint	','	1	
Patient ID	Alphabetical & numerical	13	Unique ID for each patient
Breakpoint	','	1	
Patient name	Alphabetical & numerical	13	Patient name
Breakpoint	','	1	
Species	Numerical	2	0 to 99 [2 characters fixed (padding by 0)]
Breakpoint	','	1	
Sex	Numerical	1	0: Male, 1: Female, 9: Stand-alone mode
Breakpoint	','	1	
Age	Numerical	3	999: Stand-alone mode 3 characters fixed (padding by 0)
Breakpoint	','	1	
Sample position	Numerical	2	Sample position on the sample disk ('01' fixed)
Breakpoint	','	1	
Number of tests	Numerical	2	0 to 5 (number of test names) (2 characters fixed (padding by 0) : "00" to "05"
Breakpoint	','	1	
Test name	Alphabetical & numerical	8	Test name (Max. 6 characters) + Space (20h)
Breakpoint	','	1	
Equal sign		1	Equal sign or unequal signs
Breakpoint	','	1	
Test result	Alphabetical & numerical	9	Test result (9 characters)
Unit	Alphabetical & numerical	6	Unit (6 characters)
Breakpoint	','	1	
Dilution factor	Numerical	2	Used dilution factor (from 01) ('01' fixed)
Breakpoint	','	1	
Reference interval lower limit	Numerical	5	Setting of reference interval lower limit
Breakpoint	','	1	
Reference interval upper limit	Numerical	5	Setting of reference interval upper limit
Breakpoint	','	1	
Warning	Alphabetical	11	See the following specification.
Test name breakpoint	','	1	Breakpoint
Delimiter	ETX	1	ETX: 03h
BCC			

Test result field

NOTE: The test result field has "Number of tests" of test results.

NOTE: A test name breakpoint must NOT be added at the end of the last test result field.

NOTE: Each data area is a fixed-length field, so that data should be embedded from the left and spaces (20h) should be embedded in the remaining spaces.

NOTE: "Sex" and "Age" fields

In the 2-way communication, the data send with the "Request for Worklist index" should be copied into the "Sex" and "Age" fields.
In the stand-alone mode, the "Sex" field should be embedded with "9", and the "Age" field with "999".

NOTE: The Sample position should be fixed as "01".

NOTE: The "Number of tests" is the number of test names, which is max. 5.

NOTE: As the Sample type is single, the Test name field (fixed 8-length field) should be embedded with a test name (max. 6) from the left and spaces (20h) should be embedded in the remaining field.

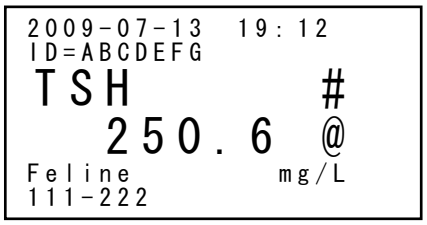
NOTE: The Dilution factor should be fixed as "01".

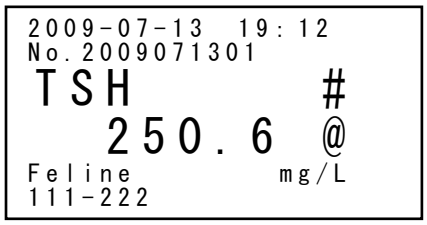
(a) Warning characters

The below table indicates warning character allocation in the warning data field.
When no error has occurred for each, a space (20h) will be embedded.

Position (sending order)	Warning character	Description
1st	H	Testing value exceeds the upper limit of the preset reference interval.
	L	Testing value falls below the lower limit of the preset reference interval.
2nd	@	Testing value is outside of the determination range.
3rd	#	The valid term of the reagent cartridge has expired.
4th		Always a space (20h)
5th	*	The disposal box opened during measurement process.
6th		Always a space (20h)
7th		Always a space (20h)
8th		Always a space (20h)
9th		Always a space (20h)
10th		Always a space (20h)
11th		Always a space (20h)

Transmission example
<Test result>





(Ex.)

Test condition	NORMAL
Test date	2009-07-13
Test time	19:12
Sample No.	2009071301
Patient ID	ABCDEFG
Patient name	Taro Fuji (Not displayed on LCD)
Species	15: Feline
Sex	0: Male
Age	003: 3 years
Sample position	01 fixed
Number of tests	01: 1 test
Test name	v-TSH
Equal sign	=
Test result	250.6
Unit	mg/L
Dilution factor	01 fixed
Reference interval lower limit	111
Reference interval upper limit	222
Warning	□@#□□□□□□□□

<Transmit data>

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	STX	R	,	N	O	R	M	A	L	□	,	2	0	0	9
2	-	0	7	-	1	3	,	1	9	:	1	2	,	2	0
3	0	9	0	7	1	3	0	1	□	□	□	,	A	B	C
4	D	E	F	G	□	□	□	□	□	□	,	T	a	r	o
5	□	F	u	j	i	□	□	□	□	,	1	5	,	0	,
6	0	0	3	,	0	1	,	0	1	,	v	-	T	S	H
7	□	□	□	,	=	,	2	5	0	.	6	□	□	□	□
8	m	g	/	L	□	□	,	0	1	,	1	1	1	□	□
9	,	2	2	2	□	□	,	□	@	#	□	□	□	□	□
10	□	□	□	ETX	BCC										

□ = Space

(5) Error information

This is used when the analyzer sends error information to PC.

Item	Character	Size	Description
Header	STX	1	STX: 02h
Command type	'E'	1	Error information command
Breakpoint	','	1	
Error event date	Numerical	10	Year, month, and day when the error occurred. (Ex: 2006-06-12)
Breakpoint	','	1	
Error event time	Numerical	8	Time when the measurements performed. (Ex: 10:30:50)
Breakpoint	','	1	
Error number	Alphabetical & numerical	5	Error number
Breakpoint	','	1	
Number of added info	Numerical	1	Number of added info (0 to 9)
Breakpoint	','	1	
Added info 1	Alphabetical & numerical	6	Added info on the error
Breakpoint	','	1	
...			
Added info n	Alphabetical & numerical	6	Added info on the error
Delimiter	ETX	1	ETX: 03h
BCC			

Added info field

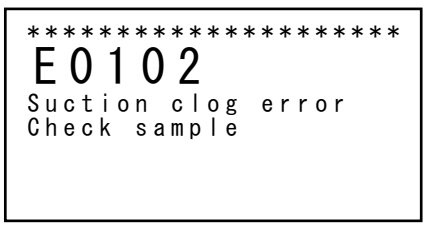
NOTE: The added info field has "Number of added info" of data.

NOTE: A breakpoint must NOT be added at the end of the last added info field.

NOTE: Each data field is a fixed-length field, so that data should be embedded from the left and spaces (20h) should be embedded in the remaining field.

<Ex.> When suction clogging error (E0110) has occurred:

[Error display]



(Transmit data)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	STX	E	,	2	0	0	6	-	0	6	-	1	2	,	1
2	0	:	3	0	:	5	0	,	E	0	1	1	0	,	1
3	,	1	.	0	0	0	□	ETX	BCC						

□ = Space

(6) Test results information (For 1-way communication: Type 2)
In the case of 1-way communication, this function is used to send tests results from the analyzer to PC.
The communication data format for the 1-way communication is same as “(4) Test results information (For 2-way communication)”.

(7) Test results information (For 1-way communication (conventional): Type 3)
This is used when the analyzer sends test results to PC in the 1-way communication mode.

Item	Character	Size	Description
Header	STX	1	STX: 02h
Test condition	Alphabetical	7	Selecting control measurements or normal measurements (CONTROL or NORMAL□)
Test date	Numerical	10	Year, month, and day when the measurements performed. (Ex. 2006-09-25)
Test time	Numerical	5	Time when the measurements performed. (Ex. 10:50)
Sequence No.	Numerical	13	Unique No. for each sample
Sample ID	Alphabetical & numerical	13	Unique ID for each sample
Sample position	Numerical	2	Sample position on the sample disk (‘01’ fixed)
Test name/ Sample type	Alphabetical & numerical	7	Test name (Max. 6 characters) + Space (20h)
Equal sign	Alphabetical	1	Equal sign or unequal signs
Test result	Numerical	9	Test result (9 characters)
Unit	Alphabetical	6	Unit (6 characters)
Dilution factor	Numerical	2	Used dilution factor (from 01) (‘01’ fixed)
Warning	Alphabetical	11	
Delimiter	ETX	1	ETX: 03h
~~BCC~~		~~1~~	

Test result field

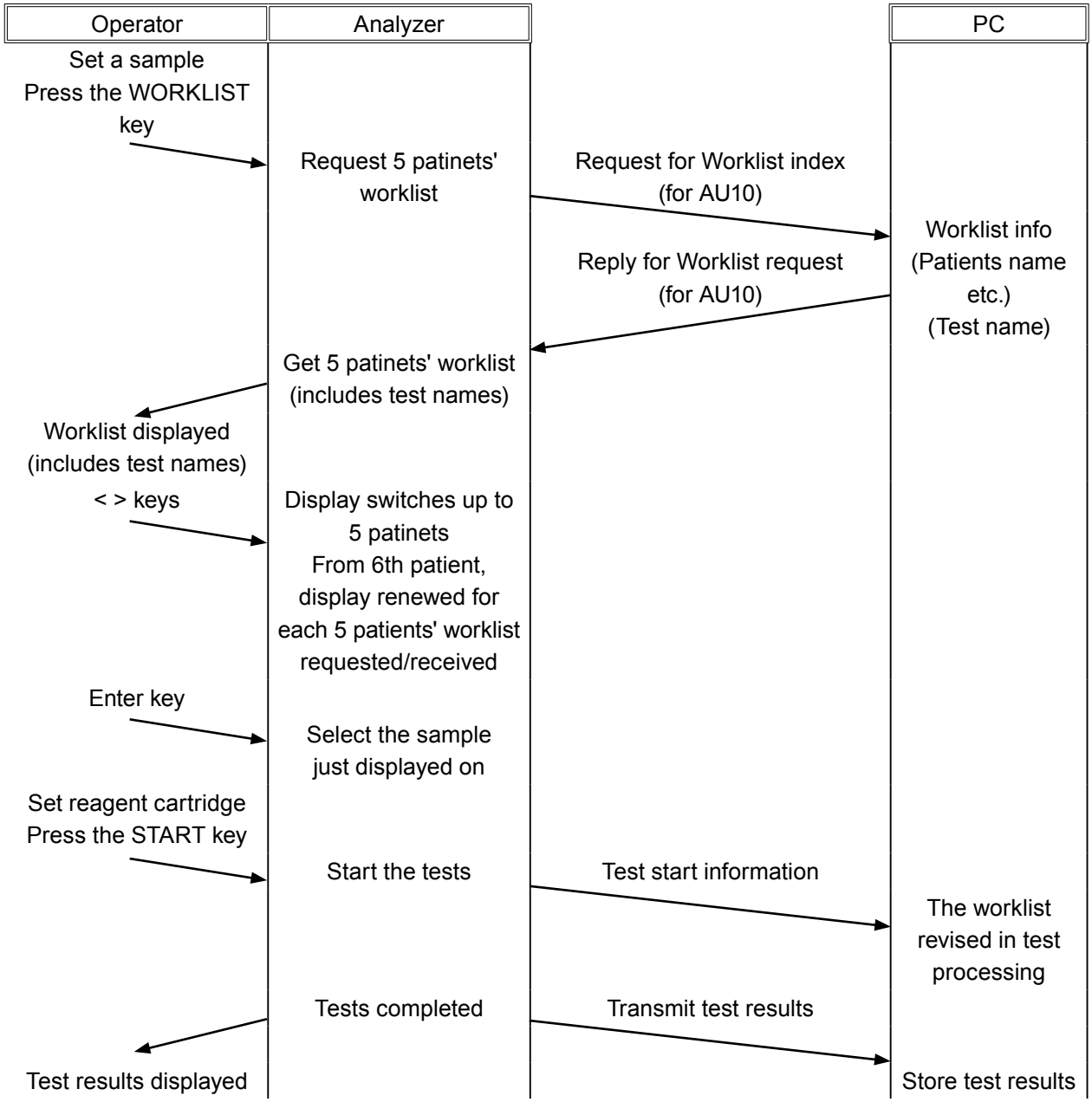
NOTE: The test result field has “Number of tests” of test results.

NOTE: Refer to (4) (a) for the warning specifications.

"BCC" is not included in Type3

6.6.6 Data Transmission Flow

(1) Single sample test (Type 1)



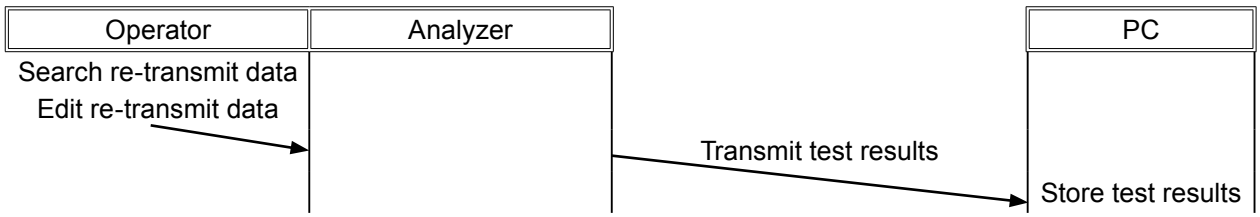
NOTE: Pressing the WORKLIST key requests the Worklist (includes test names) for 5 patients.

NOTE: The display info switches up to 5 patinets by the < >keys. When the 6th patient is assigned by the > key, the analyzer requests a pack of 5 patients' worklist to display.

NOTE: When using a sample barcode reader, reading a barcode selects a patient ID to request the Worklist using the patient ID as a key.

NOTE: Pressing the START key selects the patient's sample which is just designated to start the testing.

(2) Re-transmitting test results (Type 1, Type 2)
This function is used to re-transmit test results manually. (This is useful when electric power failure or cable disconnection caused the communication interruption.)



(3) Transmitting test results (1-way communication: Type 2, Type 3)
This is 1-way transmission of test results.