15. SYSTEM INTERFACE

15.1 Outline

In URISYS 2400, the measurement data is transmitted to the external computer connected to the main body of the Instrument by the RS-232C cable.

The communication protocol is basically assumed to be ASTM form. However, to reduce the communication frequency, one part of the relation between the record and the frame is changed. (Refer to 15.4 Outline of ASTM communication protocol)Moreover, it is assumed that only measurement data is transferred from URISYS 2400. (Refer to 15.5 Data structure)

15.2 Communication specification

(1) Table 15-1 shows the communication specifications.

Table 15-1 Communication specifications.

No.	Item	specification	Remarks	Default Value
1.	Interface	RS-232C (1Port)		
2.	Communication protocol	ASTM		
3.	Communication method	Half duplex		
4.	Synchronous method	Synchronous system		
5.	Data bit	7 , 8 bit	Setting from screen	7 bit
6.	Start bit	1 bit		
7.	Stop bit	1 , 2 bit	Setting from screen	2 bit
8.	Parity check	NONE,ODD,EVEN	Setting from screen	EVEN
9.	End of data code	ETX+C1*+C2*+CR+LF *C1,C2=check Sum		
10.	Baud rate	4800bps,9600bps	Setting from screen	9600bps
11.	Flow control	Xon/Xoff,off		
12.	Text code	ASCII		
13.	Text mode	Non transparent mode		
14.	Max. volume of transferred data per frame	247 Byte		
15.	Cable length	15m max.(RS-232C)		

15.3 Communication control

The communication control is shown as follows.

15.3.1 Default Setting

When the Instrument is started up, the state of the first stage is generated according to the HOST ON/OFF setting of the start condition screen. When the communication is assumed to be a state of idling for ON Line, transmitting and receiving are enabled. When the communication is assumed to be a state of idling for OFF Line, transmitting and receiving are disabled.

15.3.2 Communication establishment (Link establish)

A real-time forwarding or the batch forwarding of the measurement data is executed for HOST ON Line. See Fig. 15-1 below for procedure to establish communications between URISYS 2400 and HOST.

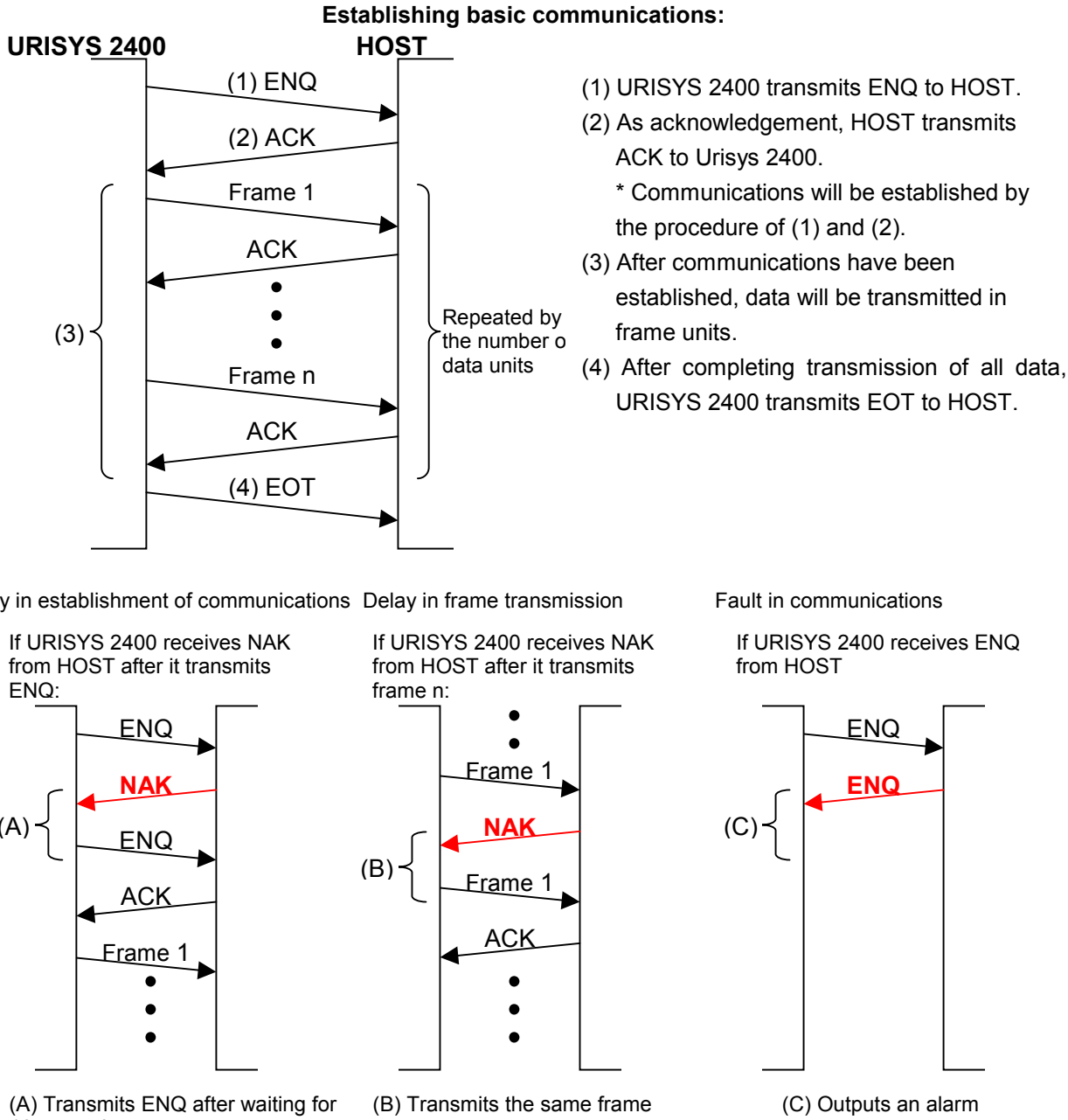

Fig. 15-1 Communication Establishment Procedure

15.3.3 State transition

The state transition table in the communication program is shown in the following Table 15-3 are shown. Moreover, the state transition chart is shown in Fig. 15-2.

Table 15.2 State transition table

No.	Status	Event (Note1)	ACK	NAK	ENQ	Time out (15Sec)	Automatic end
0	IDLE	1	-	-	-	-	0
1	ENQ transmission	-	-	-	-	-	2
2	Wait 1	-	3	2 (Note2)	-	0	-
3	Next frame set (Presence judgment)	-	-	-	-	-	4or7 (Note 3)
4	Frame transmission	-	-	-	-	-	5
5	Wait 2	-	3	6	-	0	-
6	Old frame set	-	-	-	-	-	4 (Note 4)
7	EOT transmission	-	-	-	-	-	0

Note1) Event means the transmission of data in the Instrument request.

Note2) The instrument waits for ten seconds, and transmits ENQ again.

Note3) When next frame set ending is automatic, EOT is transmitted without the next frame.

Note4) Retry is assumed up to six times.

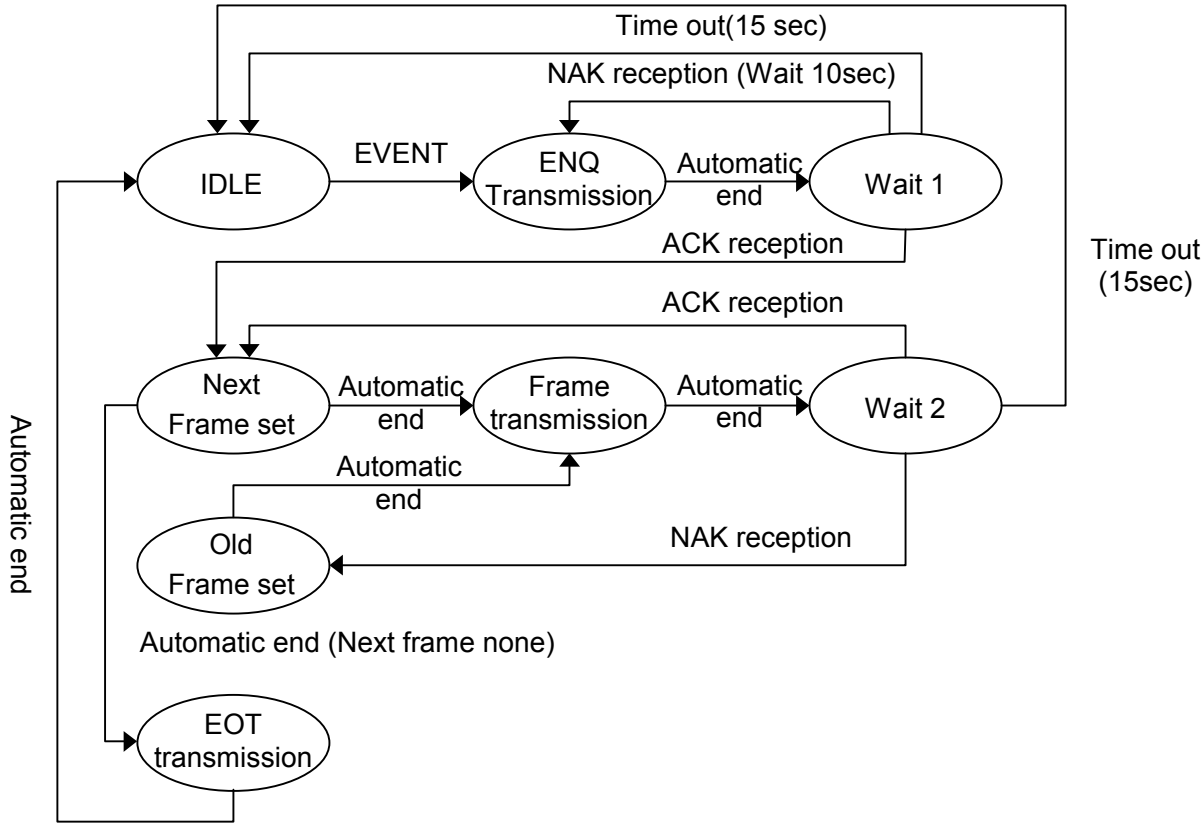

Fig.15.2 State transition chart

15.4 Outline of ASTM communication protocol

In URISYS 2400, the ASTM is used as the communication protocol.
An outline of the ASTM communication protocol is described below. Refer to the following document for the detailed specifications of the ASTM communication protocol.

1) Specification for Low-Level Protocal to Transfer Messages Between clinical Laboratory Instruments and Computer Systems (Designation:E1381-91)
2) Standard Specification for Transferring Information Between clinical Instruments and Computer Systems (Designation:E1394-91)

15.4.1 Communication data structure

(1) In the ASTM communication protocol, communication data is managed by dividing it into message, record, and frame.
(2) The correlation of message, record, and frame is shown in Fig. 15.3. However, the correlation shown in Fig. 15.4 in URISYS 2400 is assumed.
(3) The communication data communicates messaging.
(4) One message is composed of two or more record groups.
(5) One record is composed of one or two or more frame groups. However, the frame is composed of plural record groups in URISYS 2400.
(6) Actual data is transmitted in each frame.

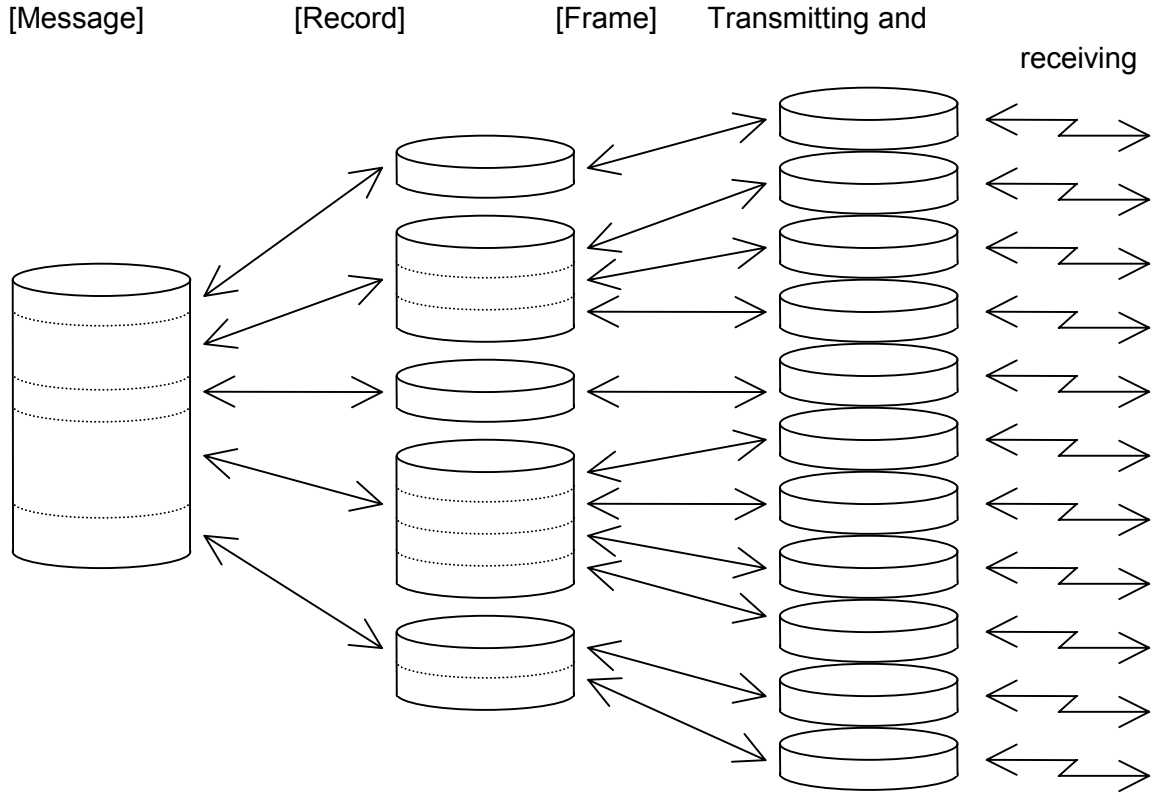

Fig.15.3 ASTM control data correlation chart

[Message] [Record] [Frame] Transmitting and receiving

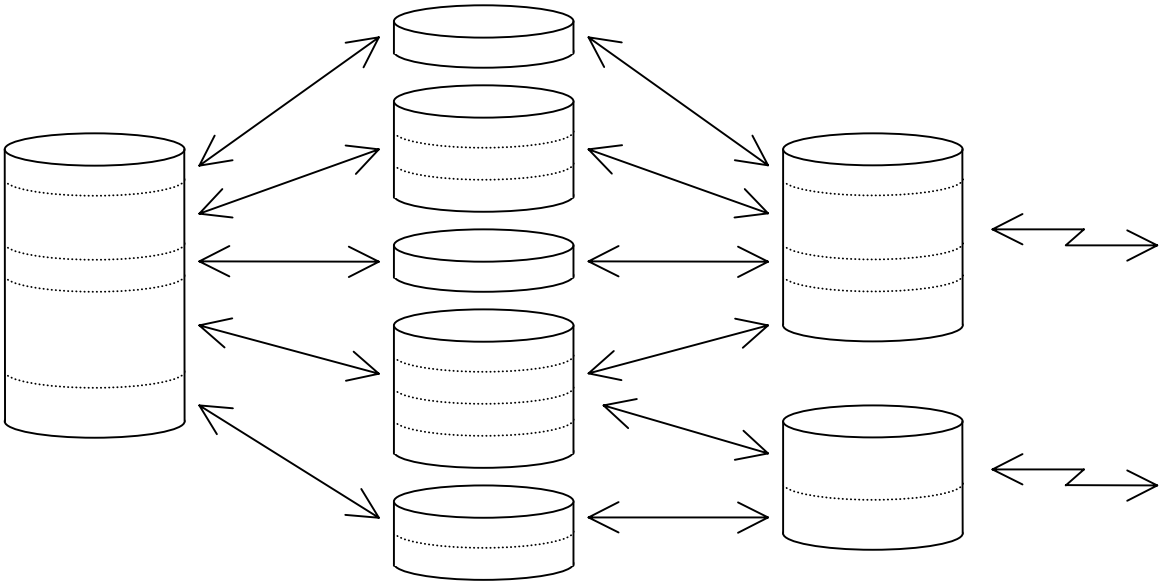

Fig. 15.4 URISYS 2400 data correlation chart

15.4.2 Frame structure

(1) The structure of the frame is shown below.

Text start code	1 byte
Frame no.	1 byte
Record (transfer data)	7-240 bytes
Text end code	1 byte
Checksum C1 C2	1 byte
End code <CR> <LF>	2 bytes

Fig. 15-5 Frame Structure

a) Test start code <STX> (=$02)

b) Frame no. '0'-'7' (character code)

1. Frame no. is allocated in the order of frames to be transferred.
2. FN='1' is set to the first transfer frame, and then the FN data is set to frames to be transferred subsequently up to '7' in the order of transfer. ('0' will follow '7', and then '1', '2' ... will be set again.)

c) Record (transfer data) ASCII codes other than the following are available:

Code (hexadecimal)	Code (hexadecimal)	Code (hexadecimal)	Code (hexadecimal)	Code (hexadecimal)
<NUL> ($00)	<ACK> ($06)	<DC1> ($11)	<ETB> ($17)	< GS > ($1D)
<SOH> ($01)	< BS > ($08)	<DC2> ($12)	<CAN> ($18)	< RS > ($1E)
<STX> ($02)	< LF > ($0A)	<DC3> ($13)	< EM > ($19)	< US > ($1F)
<ETX> ($03)	< SO > ($0E)	<DC4> ($14)	<SUB> ($1A)	<DEL> ($7F)
<EOT> ($04)	< SI > ($0F)	<NAK> ($15)	<ESC> ($1B)	($FF)
<ENQ> ($05)	<DLE> ($10)	<SYN> ($16)	< FS > ($1C)	

d) Text end code <EXT>(=$03)/<ETB>(=$07)

1. If one record length is over 240 bytes, it will be stored in frames in steps of 240 bytes, and the end code will be set to <ETB>(=$17). The text end code of the frame that stores the last portion of record (within 240 bytes) will be set to <EXT>(=$03).

e) Checksum: Upper C1 and Lower C2

1. Character codes from b) frame no. to d) end code will be added.
2. The last 2-digit (16^0, 16^1) values of sum (hexadecimal) will be respectively converted to character codes.
3. The character codes* of 16^1 and 16^0 values will be stored in upper byte C1 and lower byte C2 of checksum, respectively.

* '0'-'9' and 'A'-'F' are used for character codes.

f) End code: Upper (<CR>), Lower (<LF>)

15.4.3 Record structure

(1) The following shows the record structure:

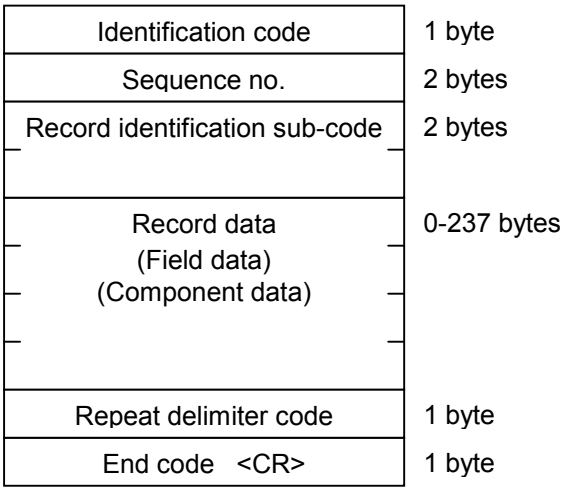

Fig. 15-6 Record Structure

a) Identification code: H, L, P, O, R, C and M are used for each record.
   1. Code that defines the type of record: This code determines the structure of the following data.

b) Sequence no.: 1-65535
   1. One message is composed of multiple records: If multiples of the same record exist within a message, sequence numbers are used to control each record.
   2. The first sequence number is '1', and then the numbers are sequentially set in ascending order until the subsequent conditions are met.
   3. Not used for records with identification code = "H".

c) Record identification sub-code: RR/RC
   1. Only records with identification code = "M" use this record identification sub-code.

d) Record data: Field/component data
   1. Field data: Data separated by field delimiter code = "|" (1 byte)
   2. Component data: Data separated by component delimiter code = "^" (1 byte) in field data

e) Repeat delimiter code: A/N
   1. Used when multiple field data items are within the same field. However, this is not used in URISYS 2400.

f) End code: <CR>(=$OD)
   1. Each record must be suffixed by carriage return.

* See "15.5.3 Forwarded data composition" for details on each record.

15.4.4 Message structure

(1) The following shows the message structure:

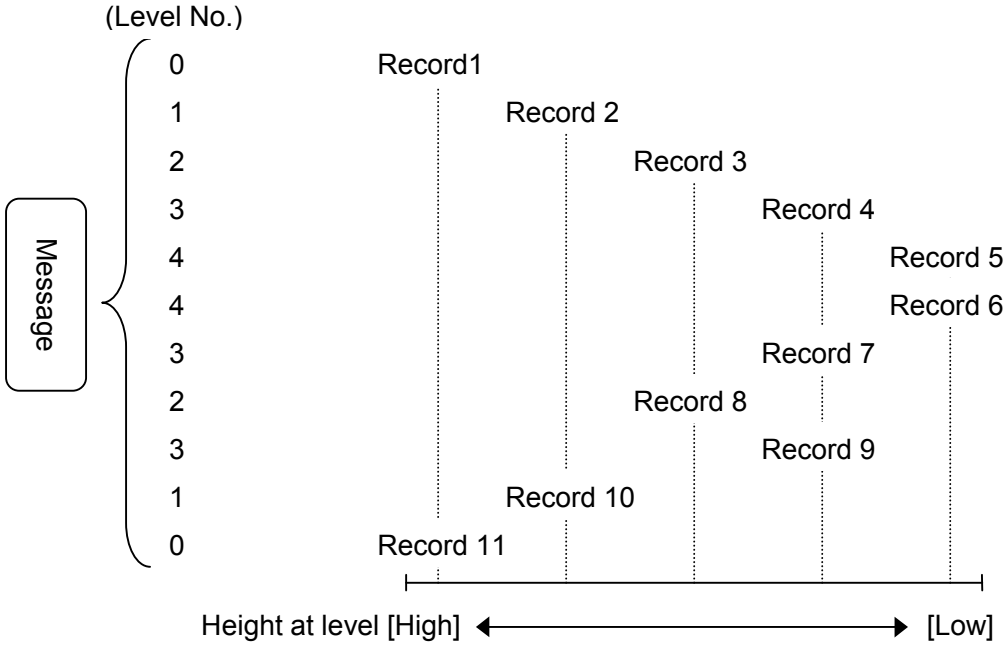

Fig. 15-7 Structure of Message

a) Message

1. A message is composed of at least two records.
2. Records making up a message form a hierarchical structure, according to the magnitude of record level.
3. A header record and a terminator record must always be respectively allocated to the start record and end record of message.

b) Record level

1. The magnitude of record level is determined by the level numbers allocated to each record. (The smaller the record number, the higher the record level.)
2. Records with level no. 0 are the header record (record identification code = “H”) and terminator record (record identification code = “L”) only.

c) Allocation of records in message

1. If the record that follows is different, “record with level no. larger by one” or “record with level no. smaller” can be allocated.
2. If the record that follows is identical, allocation is possible.

* See “15.5.4 Message forwarding” for message structure used in URISYS 2400.

15.5 Data structure

15.5.1 Real time data transfer

When Routine, the STAT, and the control Sample are measured with URISYS 2400 with an external computer connected, the measurement result is in real time forwarded to an external computer. The forwarded data is assumed to be density data (qualitative data).

15.5.2 Batch data transfer

The batch forwarding function is a function to forward the measurement data of the sample which has been measured to an external computer. It is assumed that the state of the Instrument is standby. Moreover, forwarding can be discontinued by inputting the QUIT key.

(1) Routine and STAT Sample data transfer

The Sample is specified on the routine data monitor media screen, and “SEND" is executed. As a result, the density data of a specified sample is forwarded to an external computer.

(2) Control specimen data transfer

The specimen is specified on the control data monitor media screen, and “SEND" is executed. As a result, the density data or the reflectivity data of a specified Sample is forwarded to an external computer. The selection of the density data and the reflectivity data is as follows:

- “CONC” is selected on the control data monitor screen :Density data transfer
- “Reflectance” is selected on the control data monitor screen :Reflectivity data transfer

15.5.3 Forwarded data composition

The forwarding data comprises of the following communication record in URISYS 2400. Table 15-3 shows the communication record.

Table 15-3 Communication record type

Record identification code	Record identification sub-code	Level No.	Record name	Content
H	-	0	Message Header	Message first record
L	-	0	Termination Record	Message final record
P	-	1	Patient Infor.	Sample attribute
O	-	2	Test Order	Item selection information (Sample Information)
R	-	3	Result	Measurement Data
C	-	ANY	Comment	Comment
M	RR	4	Raw Result	Reflectivity data and SG / CLA data
M	RC	4	Test Context	Measurement environment

* Can be omitted for unused data.

* Each record should be terminated with “carriage return”.

(1) Details of Record

H Record

Message Header Record [H Record]				**Pattern**
Field		Data Type	Data content	I-1/L-1
1	record type ID (H)	char[1]	H	H
2	delimiter definition	char[4]	|\^&	|\^&
3	message control ID	text		[NONE]
4	access password	text		[NONE]
5	sender name or ID	text{^...}		*1)
6	sender street address	text		[NONE]
7	reserved field			[NONE]
8	sender telephone number	text		[NONE]
9	characteristics of sender	text		[NONE]
10	receiver ID	text		[NONE]
11	comment of special instructions	text		[NONE]
12	processing ID	char[1]	P	production
13	version No.	int		*2)
14	date and time of message	d_t		[NONE]

Exp.) 1H|\^&|||6146000-00-15|||||||P|(CR)

*1) sender name or ID : Product No.(XXXX-XXX)

*2) version No. : Version # of the software

L Record

Termination Record [L Record]				**Pattern**
Field		Data Type	Data content	I-1/L-1
1	record type ID (L)	char[1]	L	L
2	sequence number	pos_int	1	1
3	termination code	char[1]		*3)

Exp.) L|1||(CR)

*3) null : for normal end of message

✦ P Record

Patient Info Record [P Record]				**Pattern**
Field		Data Type	Data content	I-11
1	record type ID (P)	char[1]	P	P
2	sequence number	pos_int		
3	practice assigned patient ID	text		[NONE]
4	laboratory assigned patient ID	text		[NONE]
5	patient ID No.3	text		[NONE]
6	patient name	text^text		[NONE]
7	mothers maiden name	text		[NONE]
8	birthdate	d		[NONE]
9	patient sex	char[1]		[NONE]
10	patient race-ethnic origin	text		[NONE]
11	patient address	text		[NONE]
12	reserved filed			[NONE]
13	patient telephone number	text		[NONE]
14	attending physician ID	text		[NONE]
15	special filed 1	text		[NONE]
16	special filed 2	text		[NONE]
17	patient height(in cm)	int{^unit}		[NONE]
18	patient weight in (kg)	int{^unit}		[NONE]
19	patient's known or suspected diagnosis	text		[NONE]
20	patient active medications	text		[NONE]
21	patient's diet	text		[NONE]
22	practice filed No.1	text		[NONE]
23	practice filed No.2	text		[NONE]
24	admission and discharge dates	d{\d}		[NONE]
25	admission status	char[2]		[NONE]
26	location	text		[NONE]
27	nature of altemative diagnostic code and classifiers	text		[NONE]
28	altermative diagnostic code and classification	text		[NONE]
29	patient religion	char[1] or text		[NONE]
30	marital status	char[1]		[NONE]
31	isolation status	char[3] or text		[NONE]
32	language status	text		[NONE]
33	hospital service	text		[NONE]
34	hospital institution	text		[NONE]
35	dosage category	text		[NONE]

Exp.) P|1|(CR)

O Record

Test Order Record [O Record]				**Pattern**
	Field	Data Type	Data content	I-21
1	record type ID (O)	char[1]	O	O
2	sequence number	pos_int		
3	specimen ID	text		Sample ID
4	instrument specimen ID	^text {^text} {^text} {^text} {^text} {^text} {^text} {^text}		Sample No. ^Rack ID ^Position No. ^ Operator ID ^data carrier type *4)
5	universal test ID	text ^text ^text ^text {^text} {^text} {^text} {\...}		[NONE]
6	priority	char[1]	S, R	S:STAT R:routine
7	request/ordered date and time	d_t		[NONE]
8	specimen collection date and time	d_t		[NONE]
9	collection end time	d_t		[NONE]
10	collection volume(in ml)	int{^unit}		[NONE]
11	collector ID	text		[NONE]
12	action code	char[1] {\...}	X,Q	X *5)
13	danger code	text		[NONE]
14	relevant clinical infomation	text		[NONE]

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● O Record(Continued)

15	date/time specimen received	d_t		sampling time *6)
16	specimen description (type & source)	text^text		[NONE]
17	ordering physican	text		[NONE]
18	physician's telephone number	text		[NONE]
19	user filed No.1	text		[NONE]
20	user filed No.2	text		[NONE]
21	laboratory filed No.1	text		[NONE]
22	laboratory filed No.1	text		[NONE]
23	date/time results reported or last modified	d_t		[NONE]
24	instrument change to computer system	text		[NONE]
25	instrument section ID	text		[NONE]
26	report types	char[1] {\...}		[NONE]
27	reserved filed			[NONE]
28	location or ward of specimen collection	text		[NONE]
29	nosocomial infection flag	text		[NONE]
30	specimen service	text		[NONE]
31	specimen institution	text		[NONE]

Exp.) O|1|1234567890123|777^50026^3^1^SAMPLE||R|||||X|||20000614212420|(CR)

*4) data carrier type : “CONTROL”, “SAMPLE”

*5) In case of control samples, the following two characters are added.

\Q

*6) In case of Data type is “d_t”, the following characters are set.

example : 20000622112345 (YYYYMMDDhhmmss)

YYYY:Year
MM :Month
DD :Day
hh :Hour
mm :Minute
ss :Second

☁ R Record

Result Record [R Record]				Pattern
Field		Data Type	Data content	I-31
1	record type ID (R)	char[1]	R	R
2	sequence number	pos_int		
3	universal test ID	text {^text} {^text} {^text} {^text} {^text} {^text} {^text} {^text}		^ ^ ^ Test No. *7)
4	data or measurement value	text{^...}		Results *8)
5	units	text		Units
6	reference ranges	text^text {\...}		[NONE]
7	result abnormal flags	char[1]		*9)
8	nature of abnormality testing	char[1] {\...}		[NONE]
9	result status	char[1] {\...}	X	*10)
10	date of change in instrument normative values or units	d		[NONE]
11	operator identification	text		[NONE]
12	date/time test started	d_t		[NONE]
13	date/time test completed	d_t		[NONE]
14	instrument identification	text		[NONE]

Exp.) R|5|^^^5|0.25|g/L|||||(CR)

*7) Test No (fixation)
1 : SG, 2 : pH, 3 : LEU, 4 : NIT, 5 : PRO, 6 : GLU,7 : KET, 8 : UBG, 9 : BIL, 10: ERY, 11: COL, 12: CLA

*8) Measurement data (range data of item corresponding to test no.)
If *10) result status is “X”, this field will be unassigned.

*9) Sample flags
! : ID Edit
N : Sample Short
E : Sample Empty
R : Test Strip

*10) Result status: No value with “X”

C Record

Comment Record [C Record]				Pattern
	Field	Data Type	Data content	I-41
1	record type ID (M)	char[1]	C	C
2	sequence number	pos_int		
3	comment source	char[1]	I	I
4	comment text	text{^...}		Comment for abnormal flags^ *11)
5	comment type	char[1]	I	I

Exp.) C|3|I|!^S^*|I|(CR)

*11) Data flags (If multiple flags are present, component delimiter code = "^" will be used.

! : Data Edit
S : Sieve
* : Abnormal
O : SG range over
I : Invalid
T : SG/CLA Error
: Range modification flag
C :On-board period for cassette expired
P :Photometer calibration expired
G :SG calibration expired

M-RR Record

Raw result Record [M-RR Record]				Pattern
	Field	Data Type	Data content	I-51
1	record type ID (M)	char[1]	M	M
2	sequence number	pos_int		
3	record type sub-ID (RR)	char[2]	RR	RR
4	raw result value	float		Reflectance or SG or CLA *12)

Exp.) M|1|RR|64.0|(CR)

*12) Order for raw result value (fixation)

1 : COM-B, 2 : COM-G, 3 : COM-O, 4 : ERY-G, 5 : ERY-O, 6 : LEU-G, 7 : NIT-G, 8 : KET-G, 9 : GLU-G, 10: PRO-G, 11: UBG-G, 12: BIL-G, 13: pH-G, 14: pH-O, 15: SG, 16: CLA

✕ M-RC Record

Result Context Record [M-RC Record]				**Pattern**
	Field	Data Type	Data content	I-61
1	record type ID (M)	char[1]	M	M
2	sequence number	pos_int		
3	record type sub-ID (RC)	char[2]	RC	RC
4	test strip cassette lot number	int		lot number
5	date/time test strip cassette set	d_t		set date/time
6	control name	text		Control Name
8	control identifier	text		Control No. *13)
9	control lot number	int		Control lot number

Exp.) M|1|RC|5261412|20000609112530|CONTROL-LOW□□□□|1|LOTNO00101|(CR)

□□Space

*13) Control No (fixation)

1 : LEVEL1, 2 : LEVEL2, 3 : LEVEL3

15.5.4 Message forwarding

The following shows the message structure used for URYSIS 2400 data transfer:

(1) Routine / STAT Sample

```
0     H
1       P
2         O
3           R
*             C
            : :      12 Results
3           R
*             C
0     L
 << 1 Message / 1 Sample >>
```

(2) Control Sample (Qualitative)

```
0     H
1       P
2         O
3           R
*             C
            : :        12 Results
3           R
*             C
4               M-RC
0     L
 << 1 Message / 1 Sample >>
```

(3)Control Sample (Reflectance)

```
0     H
1       P
2         O
3           R
*             C
            : :        12 Results
3           R
*             C
4               M-RR
                    :   16 Results
4               M-RR
4               M-RC
0     L
  << 1 Message / 1 Sample >>
```

15.6 Communication trace

When Trace ON is specified with Comm. Trace of the TOOL function, the content of the communication is memorized in the flash memory. The capacity of the memory is assumed to be 500 communications. When data exceeds 500, it is assumed oldest information will be overwritten. The content of the trace is output to the printer or FD by the output specification.

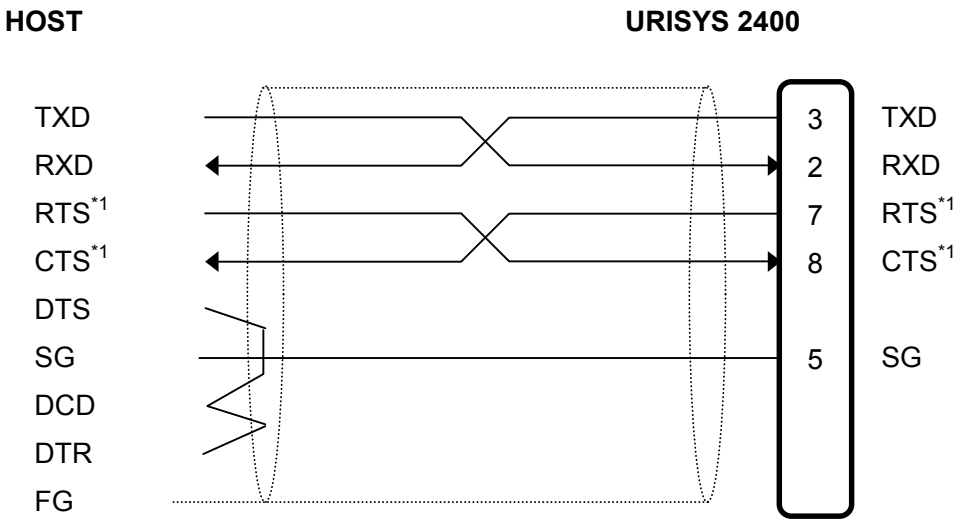
15.7 Communication alarm

Refer to 2.3 Alarm List.

15.8 ASCII Code Tables

Column / Row	0	1	2	3	4	5	6	7
0	NUL	DLE		0	@	P		p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	“	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	‘	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	I	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	-
F	SI	US	/	?	O	-	o	DEL

15.9 Host I/F schematics



*1: RTS/CTS must always be used.