



# iSED® Automated Erythrocyte Sedimentation Rate Analyzer

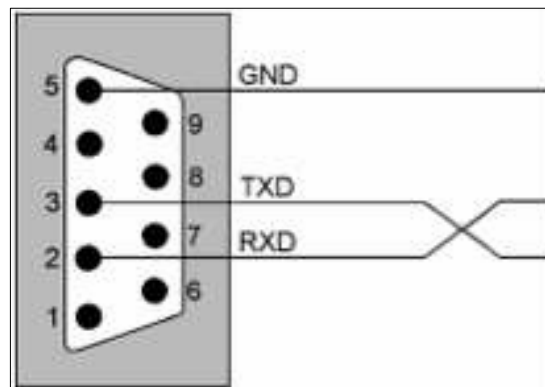
## Communication Protocol

### Scope

The scope of the present document is to describe the serial communication capabilities of the *iSED*® analyzers, providing all the necessary information to interface it to an LIS for sample result data exchange. Different protocols can be used on the *iSED*® analyzer. A connection between a computer (HOST) and *iSED*® can be performed when the protocol, the format description, and the connection mode are properly setup. *iSED*® analyzer protocol is unidirectional and follows the LIS2-A2 standard, Second Edition. The only data allowed from HOST computer to *iSED*® analyzer are the control characters. Every transmission from the HOST computer to the *iSED*® that deviates from this document, is ignored by the instrument. In every transmission, *iSED*® is the master.

### Physical Connection

The analyzer is equipped with a RS-232 DB9 male connector for data transfer. The pin-out of the connector is described in the following drawing.



### Data format

#### Connection specifications

- *Hardware and software characteristics*  
Default format for emitted character is 1 bit start, 8 data bits, No parity, 1 bit stop.  
Default communication speed is 9600 bauds.  
Hardware setting of the interface: Plug A&B are DB9 male plugs.
- *Output data characteristics*

Characters: ASCII Maximum message length: 247 characters.  
 Analyzer manages either Xon/Xoff protocol, or no flow control

- *Communication protocol*

Control Characters		
Control String	Hexadecimal Value	Direction
<ENQ>	0x05	< >
<ACK>	0x06	< >
<NAK>	0x15	< >
<STX>	0x02	>
<ETX>	0x03	>
<CR>	0x0D	>
<LF>	0x0A	>
<EOT>	0x04	>
<XON>	0x11	<>
<XOFF>	0x13	<>

Typical discussion between instrument and host		
<i>iSED</i> <sup>®</sup>	< >	Host
<ENQ>	>	
	<	<ACK>
<STX>1..DATA..<CR><TX>xx<CR><L	>	
	<	<ACK>
<STX>2..DATA..<CR><TX>xx<CR><L	>	
	<	<ACK>
<EOT>	>	

### Discussion with conflict between *iSED*<sup>®</sup> and Host

- Number of transmissions if negative answer (NAK): 6
- Timeout if no response: 10 s (Automatic disconnection max.time)
- Retry timeout: Variable < 20s
- Special timing: None
- Description of other specific treatments: None

In case of ENQ\ENQ conflict *iSED*<sup>®</sup> waits 2 seconds before retrying emission.  
*iSED*<sup>®</sup> is master in case of conflict.

Discussion with conflict between <i>iSED</i> <sup>®</sup> and Host		
<i>iSED</i> <sup>®</sup>	< >	Host
<ENQ>	>	
	<	<ENQ>
<b>Wait 2 seconds</b>		
<ENQ>	>	
	<	<ACK>
<STX>1..DATA.. <cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;lf&gt;< td=""> <td>&gt;</td> <td></td> </cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;lf&gt;<>	>	
	<	<ACK>
<STX>2..DATA.. <cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;lf&gt;< td=""> <td>&gt;</td> <td></td> </cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;lf&gt;<>	>	
	<	<ACK>
<EOT>	>	

Defeat packet during discussion between <i>iSED</i> <sup>®</sup> and Host		
<i>iSED</i> <sup>®</sup>	< >	Host
<ENQ>	>	
	<	<ACK>
<STX>1..DATA.. <cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;< td=""> <td>&gt;</td> <td></td> </cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;<>	>	
	<	<NAK>
<STX>1..DATA.. <cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;< td=""> <td>&gt;</td> <td></td> </cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;<>	>	
	<	<ACK>
<STX>2..DATA.. <cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;< td=""> <td>&gt;</td> <td></td> </cr&gt;&lt;tx&gt;xx&lt;cr&gt;&lt;<>	>	
	<	<ACK>
<EOT>	>	

## DATA Format

A sequential number located after the <STX> character is inserted into each Data frame.

Frame number is set to '1' when transfer phase is initialized and is incremented by '1' for each frame up to '7' and then returns to '0'.

Frame numbers are to permit receiver to distinguish between new and retransmitted frame, in case of retransmitted frame (after a <NAK> response from Host), frame number is not incremented.

Packet Field	Definition	Transmitted Data	Number of Bytes	Comments
0	STX	0x02	1	
1	Frame Number	1 to 7, 0, ecc	1	Frame number is set to 1 and incremented by 1 for each frame up to 7 and then returns to 0
2	Data Message		Max 240	Header, Patient, Order, Result and Comment Message
3	ETX	0x03	1	
4	Checksum		2	
5	CRLF	0x0D0A	2	

Frame checksum (<STX>1...Data...<CR><ETX>X1X2<CR><LF>) is defined as module 256 of ASCII values sum between <STX> not included and <ETX> included characters: 1...Data...<CR><ETX>.

X1 is the most significant hexadecimal digit of the checksum expressed in ASCII character, and X2 is the last significant hexadecimal digit of the checksum expressed in ASCII character.

## Records General Format Specifications

Data frames encapsulate records which further encapsulate in fields.

### Example of record inside Data frame

```
<STX>1...Data...<CR><ETX>xx<CR><LF>
```

```
<STX>1H|^&|||Alcor^iSED^01.00A^01|||||||1|20130301144108<CR><ETX>83<CR><LF>
```

**iSED®** uses the following messages:

Record ID	Definition
H	Header
P	Patient
O	Order
R	Result
L	Terminator

### Structure of Records For Result Transmission

H (Header)  
 ..P (Patient)  
 ....O (Order)  
 ....R (Result)  
 L (Terminator)

## Description of Records

- *iSED*<sup>®</sup> uses only the fields described with their specified length in further tables.
- Length of field can be less than maximum value but must not be more.
- Only «Sample ID» and «Test» fields from Order record must be informed.
- All other fields are optional.
- Delimiter must be used even if field is empty.
- Delimiters inside records are separated by «|» (ASCII \$7C).  
Delimiters inside fields are separated by «^» (ASCII \$5E).

### Header Record

Field	Definition	Transmitted data	Length
1	Record type	H	1
2	Delimiter definition	' ' field delimiter '\' repeat delimiter '^' component delimiter '&' Escape delimiter	4
3	Message control ID		
4	Access Password		
5	Sender Name	Alcor^iSED^SWver^instrument # ( see note 1)	20
6	Sender address		
7	Reserved		
8	Sender telephone #		
9	Characteristic of Sender		
10	Receiver ID		
11	Comments or Special instructions		
12	Processing ID	P	1
13	Version Number	E 1394-97	9
14	Message Date and time	YYYYMMDDHHMMSS	14
<p><b>Note 1:</b> Sender name field is divided into Manufacturer ID string (ALCOR), product name ID (<i>iSED</i><sup>®</sup>), software version (eg 01.00A), analyzer ID # (from 00 to 99 possible <i>iSED</i><sup>®</sup> in the lab)</p>			

### Patient Record

Field	Definition	Transmitted data	Length
1	Record type	P	1
2	Sequence number	1,2,...	2
3	Practice Assigned Patient ID		
4	Laboratory Assigned Patient ID	Patient ID	Max 30
5	Patient ID#3		
6	Patient Name		
7	Mother Maiden name		
8	Birthdate		
9	Patient Sex		
10	Patient Race-Ethnic Origin		
11	Patient Address		
12	Reserved		
13	Patient telephone number		
14	Attending Physician ID		
15	Special Field 1		
16	Special Field 2		
17	Patient Height		
18	Patient Weight		
19	Patient's Known or Suspected Diagnosis		
20	Patient Active medication		
21	Patient's diet		
22	Practice Field 1		
23	Practice Field 2		
24	Admission and Discharge dates		
25	Admission status		
26	Location		
27	Nature of alternative diagnostic code and classifiers		
28	Nature of alternative diagnostic code and classifiers		
29	Patient Religion		
30	Martial Status		
31	Isolation Status		
32	Language		
33	Hospital service		
34	Hospital institution		
35	Dosage category		

### Order Record

Field	Definition	Transmitted data	Length
1	Record type	O	1
2	Sequence number	1, 2, ...	2
3	Sample ID	Sample ID (30 chars) ^ rotor location (2	Max 33
4	Instrument Specimen ID		
5	Universal Test ID	^^^ESR	6
6	Priority		
7	Requested/Order Date and time		
8	Specimen Collection date and time		
9	Collection end time		
10	Collection Volume		
11	Collector ID		
12	Action Code		
13	Danger Code		
14	Clinical Relevant information		
15	Date and time Specimen Received		
16	Specimen descriptor		
17	Ordering Physician		
18	Physician's Tel #		
19	User Field 1		
20	User Field 2		
21	Laboratory Field 1		
22	Laboratory Field 2		
23	Date and time result reported or last		
24	Instrument Charge to computer System		
25	Instrument Section ID		
26	Report Types	P: Preliminary result	1
27	Reserved		
28	Location or ward of specimen collection		
29	Nosocomial infection flag		
30	Specimen Service		
31	Specimen institution		

### Result Record

Field	Definition	Transmitted data	Length
1	Record type	R	1
2	Sequence number	1, 2, ...	2
3	Universal test ID & LOINC code	^^^ESR^4537-7	13
4	Data or measurement value	Result from 0 to 130	3
5	Unit or set of units	mm/h	4
6	Reference range		
7	Result abnormal flag	'<' below absolute low, that is off low scale on instrument '>' above absolute high, that is off the high scale on	
8	Nature of abnormality testing		
9	Result status	P: Preliminary result X: order cannot be done	1
10	Date of change in normative values or		
11	Operator identification		
12	Date time test starting	YYYYMMDDHHMMSS	14
13	Date and time Test completed	YYYYMMDDHHMMSS	14
14	Instrument identification	01 to 99	2

### Terminator Record

Field	Definition	Transmitted data	Length
1	Record type	L	1
2	Sequence number	1	1
3	Termination Code	N: normal	1

## Management of Errors

### Management of Errors during Instrument Transmission

- During a single result transmission by the analyzer, if the host lost the transmission (Time-Out or EOT) the full message will be transmitted again after a parametrical delay (5s by default).
- After 6 consecutive NAKs are detected the file sent is deferred to later transmission.
- *iSED*<sup>®</sup> analyzer considers the line “disconnected” after 3 negative attempts, after 6 consecutive NAKs.

### Data Transmission Error Codes

Code	Description (Negative ESR Value)
-1	ESR_ERR_NOFLOW
-2	ESR_ERR_NOSPIKE
-3	ESR_ERR_REVERSE
-4	ESR_ERR_NOPOINTS
-5	ESR_ERR_TOODARK
-7	ESR_ERR_TOOCLEAR
-8	ESR_ERR_WITHDRAWAL
-9	ESR_ERR_FLOW_IN
-10	ESR_ERR_FLOW_OUT
-11	ESR_ERR_ACQUISITION
-12	ESR_ERR_TRIGGERDELAY

**\*\* Note:** there is no “-6”

Greater than “>” and less than “<” characters are indicators of out of range result, it is not actually an error code. See result Record, Field 7, for details

“>” character in the result stream indicates the result is greater than 130mm/hr.

“<” character in the result stream indicates the result is less than 1 mm/hr.