



*iSED*<sup>®</sup>

*iSED*<sup>®</sup> *ELITE*

Erythrocyte Sedimentation Rate Analyzer

COMMUNICATION PROTOCOL



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# 1. Introduction

## 1.1. Document scope

The iSED® and iSED® ELITE Automated Erythrocyte Sedimentation Rate Analyzers are automated sedimentation rate analyzers which reports sedimentation rate in mm/hr. ESR is a non-specific, quantitative result. Testing is done using EDTA/whole blood samples, obtained by venipuncture or capillary blood collection. The instrument can be used in laboratories authorized to perform tests classified as Moderately Complex under CLIA categorization by order of a physician to aid in assessing the general health status of a patient.

## 1.2. Communication introduction

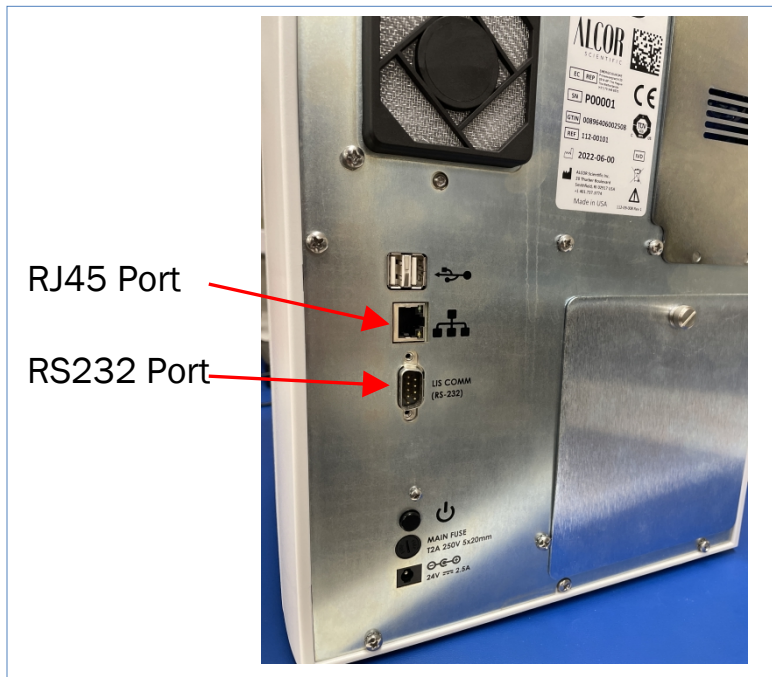
In this document, the names iSED and iSED ELITE are used interchangeably. iSED refers to devices with serial number 05000 and above. For iSED devices less than serial number 05000, please contact Alcor Technical Service.

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.

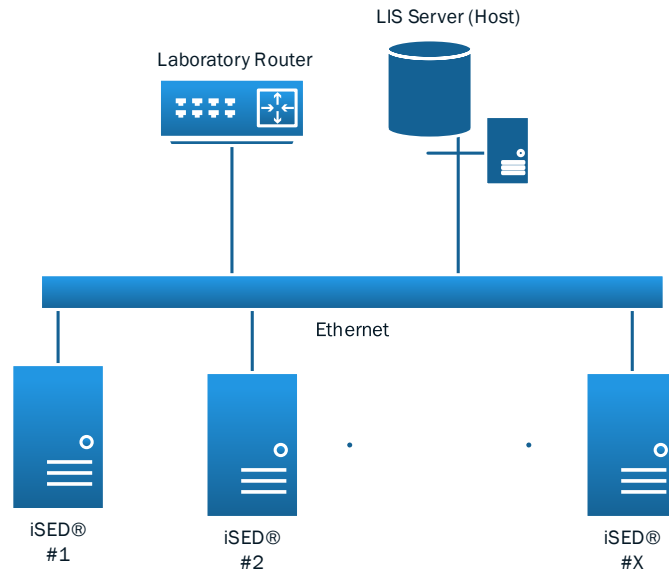
# 2. Physical Connections

The iSED analyzer is able to be connected to either a Local Area Network (LAN) through an RJ45 female connector for 10/100/1000BASE-T (TCP/IP) protocol **OR** to a RS-232 DB9 male connector for legacy connections. Only one connection “mode” can be configured at a time.

## 2.1. Fig. 1: Port locations on device

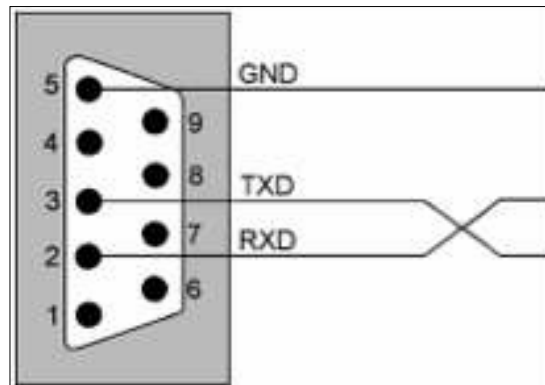


## 2.2. Fig. 2: Basic network diagram for TCP/IP connection



## 2.3. Fig. 3: RS-232 DB9 Connection

The pin-out of the DB9 connector is described in the following drawing.



### RS-232 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.

## 3. Device Setup

The iSED network and LIS settings can be accessed by the device touchscreen display. They are located in the Settings -> General Settings -> Network & LIS Configuration screen. The iSED's network and LIS settings must be configured on the device prior to communicating with the LIS Server.

### 3.1. Network settings (TCP/IP Mode Only)

Setting Name	Type	Default Value	Notes
IP Address*	Required	192.168.227.227	IPv4 or IPv6. DHCP is <b>NOT</b> currently supported on the iSED network interface. Static IP must be set on the device. Default value is not a valid IP address.
Gateway*	Required	192.168.227.1	Router IP Address. Gateway must be set on device. Default value is not a valid IP address.
Netmask*	Required	255.255.255.0	
LIS Port	Required	10000	TCP Port. Valid ports include 1025-65535

\* These settings will take effect after pressing the “Apply Changes” button.

### 3.2. LIS communication settings

Setting Name	Type	Default Value	Description
LOINC Code	Required	82477-1	LOINC code to be transmitted. See table in Section 4.2.1.4. Default code is for “Erythrocyte sedimentation rate by Photometric method”
LIS Instrument #	Required	1	If multiple iSED devices are used on the same LIS network, this is used to identify the specific iSED that is transmitting a specific record. See Sections: 4.2.1.1: Header Record, field #5 4.2.1.1: Result Record, field #14
Retry Count	Required	3	Number of times the iSED attempts to send a transmission without a <ACK> response from LIS server before producing an error.
Retry Timeout	Required	5	Amount of time, in seconds, that iSED waits for a response for each attempt before retrying.
Whitelist IPs	Optional	None	List of IP addresses that iSED is allowed to communicate with. Leaving

			this blank will allow any IP address to communicate with the iSED. Up to 10 IP addresses can be entered.
--	--	--	--

## 4. Date Format

### 4.1. Connection specifications

#### 4.1.1. Output data characteristics

Characters: ASCII Maximum message length: 247 characters.

Analyzer manages either Xon/Xoff protocol, or no flow control

#### 4.1.2. 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>	< >	Host
<ENQ>	>	
	<	<ACK>
<STX>1..DATA..<CR><TX>xx<CR><L	>	
	<	<ACK>
<STX>2..DATA..<CR><TX>xx<CR><L	>	
	<	<ACK>
<EOT>	>	

#### 4.1.3. Discussion with conflict between iSED and host

Number of transmissions if negative answer (NAK): 6

Timeout if no response: 10 s (Automatic disconnection max time)

Retry timeout: Programmable < 20s

Special timing: None

Description of other specific treatments: None

In case of ENQ\ENQ conflict iSED waits 2 seconds before retrying emission.  
iSED is master in case of conflict.

<b>Discussion with conflict between <i>iSED</i> and Host</b>		
<i>iSED</i>	< >	Host
<ENQ>	>	
	<	<ENQ>
<b>Wait 2 seconds</b>		
<ENQ>	>	
	<	<ACK>
<STX>1..DATA..<CR><TX>xx<CR><LF>	>	
	<	<ACK>
<STX>2..DATA..<CR><TX>xx<CR><LF>	>	
	<	<ACK>
<EOT>	>	

<b>Defeat packet during discussion between <i>iSED</i> and Host</b>		
<i>iSED</i>	< >	Host
<ENQ>	>	
	<	<ACK>
<STX>1..DATA..<CR><TX>xx<CR><LF>	>	
	<	<NAK>
<STX>1..DATA..<CR><TX>xx<CR><LF>	>	
	<	<ACK>
<STX>2..DATA..<CR><TX>xx<CR><LF>	>	
	<	<ACK>
<EOT>	>	

#### 4.1.4. 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.

#### 4.2. Records and general format specifications

Data frames encapsulate records which further encapsulate in fields.

<p><b>Example of record inside Data frame</b></p> <p>&lt;STX&gt;1...Data...&lt;CR&gt;&lt;ETX&gt;xx&lt;CR&gt;&lt;LF&gt;</p> <p>&lt;STX&gt;1H ^&amp;   Alcor^iSED^01.00A^01       1 20130301144108&lt;CR&gt;&lt;ETX&gt;83&lt;CR&gt;&lt;LF&gt;</p>
---

**iSED uses the following messages and structure for Result Transmission:**

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

**4.2.1. Description of records**

iSED 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).

**4.2.1.1. 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

**Note 1:** Sender name field is divided into Manufacturer ID string (ALCOR), product name ID (iSED), software version (eg v1.0.0), analyzer ID # (from 00 to 99 possible iSED in the lab)

#### 4.2.1.2. 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		
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	Marital Status		
31	Isolation Status		
32	Language		
33	Hospital service		
34	Hospital institution		
35	Dosage category		

#### 4.2.1.3. 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)	Max 30
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 modified		
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		

#### 4.2.1.4. 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^82477-1 (See note 1)	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 instrument	
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 Units		
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

**Note 1:** The specific LOINC Code can be changed through the Network & LIS Settings menu in the User Interface of the iSED. Default value is shown in this table.

#### 4.2.1.5. Terminator record

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

### 4.2.2. Management of errors

#### 4.2.2.1. Management of errors during instrument transmission

During a single result transmission by the analyzer, if the host lost the transmission (Time-Out or NAK) the full message will be transmitted again after a delay defined by the Retry Timeout setting (5 seconds by default). The transmission will make a number of attempts as defined by the Retry Count setting (3 attempts by default). If the maximum number of failed transmissions reaches the number specified by the Retry Count setting, the transmission of the full result record will be aborted.

iSED analyzer considers the line “disconnected” after 3 negative attempts, after 6 consecutive NAKs.

**4.2.2.2. Data transmission of 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
-14	ESR_ERR_LOW_CONTROL_HIGH
-15	ESR_ERR_HIGH_CONTROL_LOW

**\*\* Note: there is no “-6” and “-13”**

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.

**5. Revision History**

Revision Letter	Effective Date	Description
0	February 1, 2023	Initial release for Software v1.0.0



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