

Longer's RS485 Protocol for BT100-1L

1. Data Format: 1start + 8data + 1even parity + 1stop, 1200bps.

This defines the data format: 1 start bit, 8 data bits, one even parity bit, and one stop bit at 1200 bits per second.

2. Command Format: flag+ addr + len + pdu + fcs.

flag: E9H is the start **flag** of a command string. Every command string is preceded with the start of E9H.

- In one command string, there is no other E9H except start **flag** E9H. When transmitting, E8H is replaced by E8H 00H, and E9H is replaced by E8H 01H except start **flag**. When receiving, E8H 00H is replaced by E8H, and E8H 01H is replaced by E9H.

addr: Pump address (i.e. Pump I.D.#.), take up 1 byte.

- The pump address can be set from 1 to 30. 31(1F) is broadcast address.

- In a command string from the control computer, if the **addr** is pump address, the corresponding pump will execute the command and respond. And if the **addr** is broadcast address, all the pumps execute the same command, and pumps don't respond.

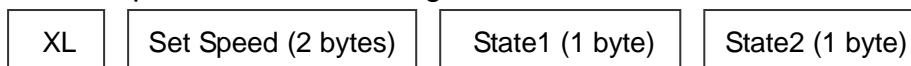
len: Length of **pdu**, take up 1 byte.

Fcs: XOR of **addr**, **len**, **pdu**, take up 1 byte.

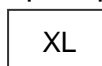
3. Pdu Format: application layer code format

3.1 Write Running Parameter With Rotate Speed

Control computer command string:



Pump response:



- Speed unit: 0.1 rpm.

- In a command string from the control computer, the **addr** can be pump address (1-30) and broadcast address (31). When the **addr** is pump address, the corresponding pump will execute the command and respond. When the **addr** is broadcast address, all the pumps execute the same command, and pumps don't respond.

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3.2 Read Running Parameter With Rotate Speed

Control computer command string:

DL

Pump response:

DL Show Speed (2 bytes) State1 (1byte) State2 (1 byte)

- Speed unit: 0.1 rpm.
- In a command string from the control computer, if the **addr** is one pump's address (1-30), the corresponding pump will respond.

3.3 Write Running Parameter With Flow and Pump Head & Tube

Control computer command string:

WL Set flow (4 bytes) State1 (1byte) State2 (1 byte)

Pump Head No. (1 byte) Tube No. (1 byte)

Pump response:

WL Show flow (4 bytes)

- Flow unit: nL/min, 1 L=10³ mL=10⁶ μL=10⁹ nL.
- In a command string from the control computer, the **addr** can be pump address (1-30) and broadcast address (31). When the **addr** is pump address, the corresponding pump will execute the command and respond. When the **addr** is broadcast address, all the pumps execute the same command, and pumps don't respond.

3.4 Read Running Parameter With Flow and Pump Head & Tube

Control computer command string:

RL

Pump response:

RL Show flow (4 bytes) State1 (1byte) State2 (1 byte)

Pump Head No. (1 byte) Tube No. (1 byte)

- Flow unit: nL/min, 1 L=10³ mL=10⁶ μL=10⁹ nL.
- In a command string from the control computer, if the **addr** is one pump's address (1-30), the corresponding pump will respond.

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3.5 Flow Calibration

Control computer command string:

| | |
|----|---------------------|
| CL | Test flow (4 bytes) |
|----|---------------------|

Pump response:

| |
|----|
| CL |
|----|

- Flow unit: nL/min, $1 \text{ L} = 10^3 \text{ mL} = 10^6 \mu\text{L} = 10^9 \text{ nL}$.
- In a command string from the control computer, the **addr** can be pump address (1-30) and broadcast address (31). Pumps can be calibrated one by one with broadcast address.

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APPENDIX

1. The command characters in the **pdu** are characters from the standard ASCII character set.

| Command character | C | D | X | W | R | L |
|-------------------|-----|-----|-----|-----|-----|-----|
| ASCII | 43H | 44H | 58H | 57H | 52H | 4CH |

2. The most significant byte is transmitted first and the least significant byte finally when transmitting RPM and Flow. The max speed is 100.0 rpm (03E8H).

3. State1: state byte 1.

Bit 0 – start / stop bit, 1 to start the pump, 0 to stop the pump.

Bit 1 – prime bit, 1 to prime the pump at the max speed 100 rpm.

4. State2: state byte 2.

Bit 0 – cw / ccw bit, 1 to run in cw, 0 to run in ccw.

5. Default **addr** : default pump address (i.e. Pump I.D.#.): 1.

6. Pump head No.-Tube No.-Tubeing ID

| Pump Head No. | 1: DG (6-roller) | | | 2: DG (10-roller) | | | 5: DG15 | | |
|----------------|------------------|------|------|-------------------|------|------|---------|------|------|
| Tube No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Tubing ID (mm) | 0.13 | 0.19 | 0.25 | 0.38 | 0.44 | 0.51 | 0.57 | 0.64 | 0.76 |

| Pump Head No. | 1: DG (6-roller) | | | 2: DG (10-roller) | | | 5: DG15 | | |
|----------------|------------------|------|------|-------------------|------|------|---------|------|------|
| Tube No. | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Tubing ID (mm) | 0.89 | 0.95 | 1.02 | 1.09 | 1.14 | 1.22 | 1.30 | 1.42 | 1.52 |

| Pump Head No. | 1: DG (6-roller) | | | 2: DG (10-roller) | | | 5: DG15 | | |
|----------------|------------------|------|------|-------------------|------|------|---------|------|--|
| Tube No. | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | |
| Tubing ID (mm) | 1.65 | 1.75 | 1.85 | 2.06 | 2.29 | 2.54 | 2.79 | 3.17 | |

| Pump Head No. | 3: YZ1515/YZ2515 | | | | | 4: 313D | | | |
|----------------|------------------|------|------|------|------|---------|------|------|--|
| Tube No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| Tubing ID (mm) | 0.80 | 1.60 | 2.40 | 3.10 | 4.80 | 6.40 | 7.90 | 9.60 | |

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7. Examples

a. Write Running Parameter With Rotate Speed:

Control computer command string:

E9 01 06 58 4C 00 C8 01 01 DB

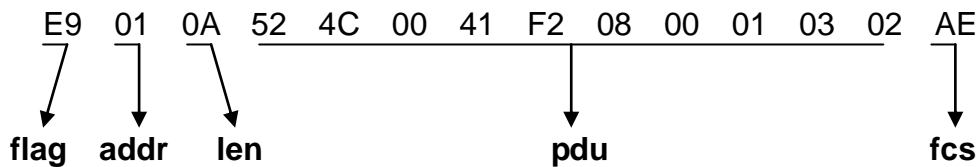
- The above command string from control computer will set running parameter of pump 1 as follows: run cw at 20.0 rpm.

b. Read Running Parameter With Flow and Pump Head & Tube:

Control computer command string:

E9 01 02 52 4C 1D

Pump response:



52 4C -- RL

00 41 F2 08 – show Flow (41F208H=4321800 nl/min=4.3218 ml/min)

00 -- stop state

01 -- Run in cw

03 – YZ1515/YZ2515 pump head

02 -- Tubing ID: 1.60 mm

8. DB-15 External Control Interface

Pin 2 - RS485 B

Pin 3 - RS485 A