



Digital Mass Flow Controller

ST-550 (RS-485 Specifications)

Communication Manual

KOFLOC Corp.

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1. Foreword

The Manual describes the specifications and operating methods of the standard RS-485 communication functions installed in the ST-550.

Prior to using them, be sure to read the Instruction Manual for the ST-550 main unit, which describes its wiring, installation and operating methods.

2. Switching to Digital Communication-based Control (Mass Flow Controller Only)

Upon shipment from the factory, the ST-550 is set to analog input-based control. To control through digital communication, initially switch a *flow rate setting method* to “Digital (0)” according to the description below. To return to analog input-based control, switch to “Analog (1)” again.

* See 5. Details of Commands, 13) WFSM: Setting the *flow rate setting method*.

When valve opening/closing input (analog signal) is “Full Close” or “Full Open”, operation follows this signal regardless of the setting of the *flow rate setting method*. Only in the “Control” mode, operation switches according to the setting of the *flow rate setting method* as shown on the next page. This operational inconsistency due to a setting difference applies only to this case.

A flow rate control range is 2% to 100% of the full scale; setting of less than 2% is not assured.

		Valve opening/closing input (analog signal)		
		Full close (−15 V)	Control (open)	Full open (+15 V)
Valve status (digital setting)	Full close (2)	Full close	Controlled according to the set voltage or current input (analog signal)	Full open
	Control (1)			
	Full open (0)			

Flow rate setting method: “Analog (1)”

		Valve opening/closing input (analog signal)		
		Full close (−15 V)	Control (open)	Full open (+15 V)
Valve status (digital setting)	Full close (2)	Full close	Full close	Full open
	Control (1)		Controlled according to the set flow rate [mantissa] (digital setting)	
	Full open (0)		Full open	

Flow rate setting method: “Digital (0)”

3. Basic Specifications

Synchronization method	Start-stop synchronization
Baud rate	38,400 bps
Start bit	1 bit
Data length	8 bits
Stop bit	1 bit
Parity	None
Transmission method	3-wire half-duplex
Insulation	Between communication and control circuit: Non-insulated Between communication and power source: Non-insulated
Communication ID setting	By the switch on the top of the controller

Using the switch on the top of the controller, set a communication ID (01 to 99) for each controller. When this is done, make sure that their IDs are respectively unique, not duplicating.

Using a user system such as a PC or PLC as a master and each controller as a slave, communication is started by sending a command message from the master and ended by returning a response message from the slave. As the master and each slave share a message communication path, follow this procedure to prevent a collision of messages.

4. Message Composition

- Command message

Make sure that the command message from the master to the controller is composed as follows.

STX	Communication ID			Command				Data	Checksum		ETX
@	0	0	1	W	V	S	S	1	5	5	CR
40H	30H	30H	31H	57H	56H	53H	53H	31H	35H	35H	0DH

STX	The controller unconditionally recognizes STX as the head of the message. “@ (40H)”, 1-byte fixed length
Communication ID	Specify the communication ID of the controller, or a destination. “001” to “009”, 3-byte fixed length
Command	Specify a character string which indicates a type of command. 4-byte fixed length. For details, see the next chapter.
Data	Variable length depending on the type of command. There are also 0-byte commands. For details, see the next chapter.
Checksum	Specify the result of adding from STX to Data every byte and converting each of the resulting lower 2 digits (hexadecimal) into the ASCII code. 2-byte fixed length. * See the below-mentioned.
ETX	This indicates the end of the message. “CR (0DH)”, 1-byte fixed length

* Checksum calculation example

In the case of the above-mentioned command message, for example, a checksum calculation looks like the following.

$$\underline{40H} + \underline{30H} + \underline{30H} + \underline{31H} + \underline{57H} + \underline{56H} + \underline{53H} + \underline{53H} + \underline{31H} = \underline{255H}$$

(STX) (Communication ID) (Command) (Data) (Checksum)

- Response message

When the communication ID set to the controller matches that specified by the command message, the controller returns a response message with the following composition.

STX	Communication ID			Command				Exit code		Data	Checksum		ETX
%	0	0	1	R	V	S	S	O	K	1	C	F	CR
25H	30H	30H	31H	52H	56H	53H	53H	4FH	4BH	31H	43H	46H	0DH

STX	“(25H)”, 1-byte fixed length
Communication ID	Communication ID of the controller, or a source. 3-byte fixed length
Command	Character string indicating the type of command contained in the command message. For details, see the next chapter. 4-byte fixed length
Exit code	Character string indicating a result to the command message. “OK” or “NG”, 2-byte fixed length
Data	Variable length depending on the type of command and the exit code. There are also 0-byte commands or signed (+ or –) commands. For details, see the next chapter.
Checksum	Result of adding from STX to Data every byte and converting each of the resulting lower 2 digits (hexadecimal) into the ASCII code. 2-byte fixed length. * See the previous page.
ETX	This indicates the end of the message. “CR (0DH)”, 1-byte fixed length

* A checksum calculation method is the same as for the command message.

5. Details of Commands

The following shows the commands executable to this controller. KOFLOC has no responsibilities for operations resulting from the use of other commands than the below-mentioned ones.

1) RCFS: Acquisition of the *full-scale flow rate [mantissa]*

Acquires the *full-scale flow rate [mantissa]*.

Used for calculating the full-scale flow rate together with the *flow rate decimal point position [decimal places]* and the *unit of flow rate*.

Data Command: None

Response: Decimal 4 digits (4-byte fixed length)

Range: 0001 to 9999

2) RDPP: Acquisition of the *flow rate decimal point position [decimal places]*

Acquires the *flow rate decimal point position [decimal places]*.

Used for calculating various flow rates together with the *unit of flow rate*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: None, 1: 1 digit, 2: 2 digits, 3: 3 digits

3) RFRU: Acquisition of the *unit of flow rate*

Acquires the *unit of flow rate*.

Used for calculating various flow rates together with the *flow rate decimal point position [decimal places]*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: cc, 1: L

4) RCFR: Acquisition of the *instantaneous flow rate [mantissa]*

Acquires the *instantaneous flow rate [mantissa]*.

Used for calculating the instantaneous flow rate together with the *flow rate decimal point position [decimal places]* and the *unit of flow rate*.

Data Command: None

Response: Sign (+/–) + decimal 4 digits (5-byte fixed length)

Range: –9999 to +9999

5) RLFD: Acquisition of the *display cut setting (“0” display within ±1% full scale)*

Acquires the *display cut setting (“0” display within ±1% full scale)*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: Disable (no display cut)

1: Enable (forced “0” display)

6) WLFD: Setting of the *display cut (“0” display within ±1% full scale)*

Sets the *display cut setting (“0” display within ±1% full scale)*.

Data Command: Decimal 1 digit (1-byte fixed length)

0: Disable (no display cut)

1: Enable (forced “0” display)

Response: None

7) RALM: Acquisition of the *alarm status*

Acquires the *alarm status*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: No alarm

1: Alarm (sensor error)

2: Alarm (valve overheat)

3: Alarm (sensor error and valve overheat)

8) ZERO: Execution of sensor zero adjustment

Makes sensor zero adjustment.

Make sure that there is no gas flow before executing this command.

Data Command: None

Response: None

9) RCVS: Acquisition of the *valve status*

Acquires the current valve status regardless of analog input or digital setting.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: Full open, 1: Control, 2: Full close

10) RCVO: Acquisition of the *valve opening*

Acquires the current *valve opening*.

Data Command: None

Response: Decimal 4 digits (4-byte fixed length)

Range: 0000 to 1000 (in steps of 0.1%)

11) RSFR: Acquisition of the *setting flow rate [mantissa]*

Acquires the *setting flow rate [mantissa]*.

Used for calculating the setting flow rate together with the *flow rate decimal point position [decimal places]* and the *unit of flow rate*.

Acquires the currently set flow rate regardless of setting of the flow rate setting method.

Data Command: Decimal 4 digits (4-byte fixed length)

Range: 0000 to 9999

Response: None

12) RFSM: Acquisition of the *flow rate setting method*

Acquires the *flow rate setting method*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: Digital, 1: Analog

13) WFSM: Setting of the *flow rate setting method*

Sets the *flow rate setting method*.

Data Command: Decimal 1 digit (1-byte fixed length)

0: Digital, 1: Analog

Response: None

14) RVSS: Acquisition of the *valve status (digital setting)*

Acquires the *valve status (digital setting)*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: Full open, 1: Control, 2: Full close

15) WVSS: Setting of the *valve status (digital setting)*

Sets the *valve status (digital)*.

Data Command: Decimal 1 digit (1-byte fixed length)

0: Full open, 1: Control, 2: Full close

Response: None

16) RSFD: Acquisition of the *setting flow rate [mantissa] (digital setting)*

Acquires the *setting flow rate [mantissa] (digital setting)*.

Used for calculating the setting flow rate (digital setting) together with the *flow rate decimal point position [decimal places]* and the *unit of flow rate*.

Data Command: None

Response: Decimal 4 digits (4-byte fixed length)

Range: 0000 to 9999

17) WSFD: Setting of the *setting flow rate [mantissa] (digital setting)*

Sets the *setting flow rate [mantissa] (digital setting)*.

Sets the setting flow rate (digital setting) together with the *flow rate decimal point position [decimal places]* and the *unit of flow rate*.

Data Command: Decimal 4 digits (4-byte fixed length)

Range: 0000 to *full-scale flow rate [mantissa]*

Less than 2% of the *full-scale flow rate [mantissa]* is considered fully closed.

Response: None

18) RALA: Acquisition of *operation at alarm occurrence*

Acquires *operation at alarm occurrence*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: Valve status continued

1: Valve forced fully closed

2: Valve forced fully opened

19) WALA: Setting of *operation at alarm occurrence*

Sets *operation at alarm occurrence*.

Data Command: Decimal 1 digit (1-byte fixed length)

0: Valve status continued

1: Valve forced fully closed

2: Valve forced fully opened

Response: None

20) RAZS: Acquisition of *sensor auto zero adjustment*

Acquires *sensor auto zero adjustment*.

Data Command: None

Response: Decimal 1 digit (1-byte fixed length)

0: Disable, 1: Enable

21) WAZS: Setting of *sensor auto zero adjustment*

Sets *sensor auto zero adjustment*.

Data Command: Decimal 1 digit (1-byte fixed length)

0: Disable, 1: Enable

Response: None

6. Flow Rate Expression

The full-scale flow rate, instantaneous flow rate, setting flow rate (digital setting) and setting flow rate are expressed by combining their respective mantissas with the *flow rate decimal point position [decimal places]* and the *unit of flow rate*.

The *flow rate decimal point position [decimal places]* and the *unit of flow rate* are commonly used for each flow rate and cannot be changed.

The following shows their examples.

<i>Full-scale flow rate [mantissa]</i>	3000
<i>Flow rate decimal point position [decimal places]</i>	1:1 digit
<i>Unit of flow rate</i>	0: cc
Full-scale flow rate	300.0 (cc)

<i>Instantaneous flow rate [mantissa]</i>	1234
<i>Flow rate decimal point position [decimal places]</i>	2:2 digits
<i>Unit of flow rate</i>	0: cc
Instantaneous flow rate	12.34 (cc)

<i>Setting flow rate [mantissa] (digital setting)</i>	0500
<i>Flow rate decimal point position [decimal places]</i>	3:3 digits
<i>Unit of flow rate</i>	1: L
Setting flow rate (digital setting)	0.500 (L)

<i>Setting flow rate [mantissa]</i>	2500
<i>Flow rate decimal point position [decimal places]</i>	1:1 digit
<i>Unit of flow rate</i>	0: cc
Setting flow rate	250.0 (cc)

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