MJ400259A1

KOFLOC Kyoto

Thermal Digital Mass Flow Meter / Controller

EX-550

RS-485 Communications Instruction Manual

KOFLOC Corp.

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1. Foreword

This document describes the specifications and handling of the RS-485 communications function installed as a standard feature in EX-550.
The wiring, installation and operating procedures, other than communications, are presented in a separate instruction manual. Prior to use, please read it also.

2. Switching to “control by digital communications”

(Mass flow controller only)

EX-550 has been set to “control by analog input” in the factory.
When you require “control by digital communications”, first change the flow rate setting method to “digital (0)” in accordance with the procedure described below. To return to “control by analog input”, change it to “analog (1)” again.

※ Reference 5. Command Details 21) WFSM: Setting of the flow rate setting method

When the valve open/close input (analog signal) is “CLOSE” (fully close) or “OPEN” (fully open), the equipment follows it regardless of the setting of the flow rate setting method. Only when “CONTROL”, the action is switched over according to the setting of the flow rate setting method as shown on the next page, but a difference in action due to a difference in setting is limited to this part and others remain the same. The flow rate control range is 2% to 100% of the full scale. The setting less than 2% is “CLOSE”.

		Valve open/close input (analog signal)		
		Fully close (-15V)	Control (OPEN)	Fully open (+15V)
The valve status (digital)	Fully close (2)	Fully close	**Controlled by flow rate setting voltage/current inputs (analog signals)**	Fully open
	Control (1)			
	Fully open (0)			

Flow rate setting method "Analog (1)"

		Valve open/close input (analog signal)		
		Fully close (-15V)	Control (OPEN)	Fully open (+15V)
The valve status (digital)	Fully close (2)	Fully close	Fully close	Fully open
	Control (1)		**Controlled by *the set flow rate [significand] (digital setting)***	
	Fully open (0)		Fully open	

Flow rate setting method "Digital (0)"

3. Basic Specifications

Synchronization	Start-stop
Transmission speed	38400 bps
Start bit	1 bit
Data length	8 bits
Stop bit	1 bit
Parity	None
Transmission system	3-wire half-duplex
Insulation	Communication – control circuit: Uninsulated Communication – power supply: Uninsulated
Communication ID setting	By use of rotary switch SW2 on top of equipment

Using the switch SW2 on the top of the equipment, set a communication ID (1 – 9) for each piece of the equipment. When setting an ID, ensure that IDs do not overlap among the equipment and are unique ones.

With the user system such as a PC and PLC as the master and this equipment as the slave, sending a command message from the master begins communications and returning a response message from the slave ends communications. Since the master and each slave share the message send/receive path, follow this procedure to ensure that messages do not collide.

4. Message Structure

・Command message

The command message from the communication controller to the equipment should be structured as shown in the following example:

STX	Communication ID			Command				Data	Check sum		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	This equipment recognizes “STX” as the head of the message unconditionally. “@(40H)” Fixed length 1 byte
Communication ID	Specify a communication ID of the equipment to which data is sent. “001” – “099” Fixed length 3 bytes
Command	Specify a character string to indicate a command type. Fixed length 4 bytes. For details, see the next section.
Data	Variable length according to command types. There are commands without data. For details, see the next section.
Check sum	Added every 1 byte from STX to data and each digit of calculation result lower 2 digits (hexadecimal) converted to ASCHII code. Fixed length 2 bytes. ※See below.
ETX	Indicates the end of the message. “CR (0DH)” Fixed length 1 byte

※An example of check sum calculation

As an example, the above command message is as follows:

40H + 30H + 30H + 31H + 57H + 56H + 53H + 53H + 31H = 255H

(STX) (Communication ID) (Command) (Data)(Check sum)

・Response message

When the communication ID that has been set to the equipment matches the communication ID specified by the command message, the equipment returns a response message as shown in the following example.

STX	Communication ID			Command				Exit code		Data	Check sum		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)” Fixed length 1 byte
Communication ID	Communication ID of source equipment. Fixed length 3 bytes
Command	A character string to indicate a command type contained in the command message. For details, see the next section. Fixed length 4 bytes.
Exit code	A character string to indicate a result of the command message. “OK” or “NG” Fixed length 2 bytes
Data	Variable length according to command types and exit code. There are commands without data (0 byte). For details, see the next section.
Check sum	Added every 1 byte from STX to data and each digit of calculation result lower 2 digits (hexadecimal) converted to ASCHII code. Fixed length 2 bytes.
ETX	Indicates the end of the message. “CR (0DH)” Fixed length 1 byte

※ The check sum is calculated by the same method as the command message.

5. Details of Commands

The commands that can be executed for the equipment will be described below. Please note that KOFLOC will bear no responsibility for motions resulting from the use of commands other than those specified here.

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

The *full scale flow rate [significand]* is acquired.
This is used to calculate the full scale flow rate currently set to the equipment together with the *flow rate decimal point position [number of decimal places]* and *flow rate unit.*

Data Command: None
Response: Decimal 4 digits (fixed length 4 bytes)
Range: 0001 － 9999

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

The *flow rate decimal point position [number of decimal places]* is acquired.
This is used to calculate various flow rates together with the *flow rate unit*.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0 : None, 1 : 1 digit, 2 : 2 digits, 3 : 3 digits

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

The *flow rate unit* is acquired.
This is used to calculate various flow rates together with the *flow rate decimal point position [number of decimal places]*.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0 : cc , 1 : L

4) RFRC : Acquisition of the *flow rate reference temperature condition*

The *flow rate reference temperature condition* is acquired.

Data Command: None
Response: Decimal 2 digits (fixed length 2 bytes)
00 : 0℃, 20 : 20℃, 25 : 25℃

5) WFRC : Setting of the *flow rate reference temperature condition*

Set the *flow rate reference temperature condition.*

Data Command: Decimal 2 digits (fixed length 2 bytes)
00 : 0℃, 20 : 20℃, 25 : 25℃
Response: None

6) RCFR : Acquisition of the *instantaneous flow rate [significand]*

The *instantaneous flow rate [significand]* is acquired.
This is used to calculate the instantaneous flow rate together with the *flow rate decimal point position [number of decimal places]* and *flow rate unit*.

Data Command: None
Response: Sign ('+' / '-') Decimal 4 digits (fixed length 5 bytes)
Range: -9999 ― +9999

7) RPGT : Acquisition of the *calibration gas type*

The *calibration gas type used for equipment calibration* is acquired.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
1 : N_2 (Nitrogen)
2 : AIR (Air)
3 : H_2 (Hydrogen)
4 : He (Helium)
5 : Ar (Argon)
6 : O_2 (Oxygen)
7 : CO_2 (Carbon dioxide)
0 : Other than above

8) RCGT : Acquisition of the *gas type*

The present *gas type* that has been set is acquired.
Selected by the switch SW1 on the top of the equipment.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
1 : N_2 (Nitrogen)
2 : AIR (Air)
3 : H_2 (Hydrogen)
4 : He (Helium)
5 : Ar (Argon)
6 : O_2 (Oxygen)
7 : CO_2 (Carbon dioxide)
8 : Other gas specified when an order is placed
9 : User custom CF mode
0 : Other than above

9) RCFM : Acquisition of the *CF value in the user custom CF mode*

The *CF value in the user custom CF mode* is acquired.
This is expressed always based on N2 (nitrogen) (1000) regardless of *calibration gas types*.

Data Command: None
Response: Decimal 4 digits (fixed length 4 bytes)
Range: 0200 － 1500

10) WCFM : Setting of the *CF value in the user custom CF mode*

Set the *CF value in the user custom CF mode*. Set this always based on N_2 (nitrogen) (1000) regardless of the *calibration gas types*.

Data Command: Decimal 4 digits (fixed length 4 bytes)
Range: 0200 － 1500
Response: None

11) RLFD：Acquisition of the *display cut setting (0 shown if within ±1%F.S.)*

The *display cut setting (0 shown if within ±1%F.S.)* is acquired.

Data Command: None

Response: Decimal 1 digit (fixed length 1 byte)

0：Disable (No display cut)

1：Enabled (Forced indication of “0”)

12) WLFD：Setting of the *display cut setting (0 shown if within ±1%F.S.)*

Set the *display cut setting (0 shown if within ±1%F.S.)*

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

0：Disable (No display cut)

1：Enabled (Forced indication of “0”)

Response: None

13) RALM：Acquisition of the *alarm occurrence status*

The *alarm occurrence status* is acquired.

Data Command: None

Response: Decimal 1 digit (fixed length 1 byte)

0：No alarm

1：Alarm present (Sensor error)

2：Alarm present (Valve overheat)

3：Alarm present (Sensor faulty and valve overheated)

14) ZERO：Execution of sensor zero adjustment

Sensor zero adjustment is executed.

Ensure that no gas is flowing before starting adjustment.

Data Command: None

Response: None

The following are commands used by the mass flow controller only.

15) RCVS：Acquisition of the *valve status*

The present valve status is acquired regardless of analog input or digital setting.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0：Fully open, 1：Control, 2：Fully close

16) RCVO：Acquisition of the *valve opening*

The present *valve opening* is acquired.

Data Command: None
Response: Decimal 4 digits (fixed length 4 bytes)
Range: 0000 － 1000 (in units of 0.1%)

17) RSFR：Acquisition of the *set flow rate [significand]*

The *set flow rate [significand]* is acquired.
This is used to calculate the set flow rate together with the *flow rate decimal point position [number of decimal places]* and *flow rate unit*.
The currently set flow rate is acquired regardless of the setting of the flow rate setting method.

Data Command: Decimal 4 digits (fixed length 4 bytes)
Range: 0000 － 9999
Response: None

18) RRDP：Acquisition of the *motion differential pressure*

The *motion differential pressure* is acquired.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0：Standard differential pressure, 1：Low differential pressure

19) WRDP：Setting of the *motion differential pressure*

Set the *motion differential pressure.*

Data Command: Decimal 1 digit (fixed length 1 byte)
0：Standard differential pressure, 1：Low differential pressure
Response: None

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

The *flow rate setting method* is acquired.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0：Digital, 1：Analog

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

Set the *flow rate setting method.*
Data Command: Decimal 1 digit (fixed length 1 byte)
0：Digital, 1：Analog
Response: None

22) RVSS：Acquisition of the *valve status (digital)*

The *valve status (digital)* is acquired.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0：Fully open, 1：Control, 2：Fully close

23) WVSS：Setting of the *valve status (digital)*

Set the *valve status (digital).*

Data Command: Decimal 1 digit (fixed length 1 byte)
0：Fully open, 1：Control, 2：Fully close
Response: None

24) RSFD : Acquisition of the *set flow rate [significand] (digital)*

The *set flow rate [significand] (digital)* that has been set is acquired.
This is used to calculate the *set flow rate (digital)* together with the *flow rate decimal point position [number of decimal places]* and *flow rate unit*.

Data Command: None
Response: Decimal 4 digits (fixed length 4 bytes)
Range: 0000 － 9999

25) WSFD : Setting of the *set flow rate [significand] (digital)*

Set the *set flow rate [significand] (digital).*
Set the set flow rate (digital) together with the *flow rate decimal point position [number of decimal places]* and *flow rate unit*.

Data Command: Decimal 4 digits (fixed length 4 bytes)
Range: 0000 － *full scale flow rate [significand]*
However, setting less than 2% of the *full scale flow rate [significand] is treated as fully closed.*
Response: None

26) RALA : Acquisition of the *response to alarm occurrence*

The *response to alarm occurrence* is acquired.

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0 : Valve control continued,
1 : Valve forced to fully closed
2 : Valve forced to fully opened

27) WALA : Setting of the *response to alarm occurrence*

Set the *response to alarm occurrence.*

Data Command: Decimal 1 digit (fixed length 1 byte)
0 : Valve control continued
1 : Valve forced to fully closed
2 : Valve forced to fully opened
Response: None

28) RAZS : Acquisition of the *sensor auto zero*

The *sensor auto zero is acquired.*

Data Command: None
Response: Decimal 1 digit (fixed length 1 byte)
0 : Disabled
1 : Enabled

29) WAZS : Setting of the *senor auto zero*

Set the *sensor auto zero.*

Data Command: Decimal 1 digit (fixed length 1 byte)
0 : Disabled
1 : Enabled
Response: None

6. Flow Rate Expression

The maximum full scale flow rate, full scale flow rate, instantaneous flow rate, set flow rate (digital) and set flow rate are expressed by a combination of the significand and *flow rate decimal point position [number of decimal places]* and *flow rate unit*. Note that *flow rate decimal point position [number of decimal places]* and *flow rate unit* are used commonly for each flow rate and cannot be changed.

Examples are presented below:

Full scale flow rate [significand]	3000
Flow rate decimal point position [number of decimal places]	1：1 digit
Flow rate unit	0：cc
Full scale flow rate	300. 0 (cc)

Instantaneous flow rate [significand]	1234
Flow rate decimal point position [number of decimal places]	2：2 digits
Flow rate unit	0：cc
Instantaneous flow rate	12. 34 (cc)

Set flow rate [significand] (digital)	0500
Flow rate decimal point position [number of decimal places]	3：3 digits
Flow rate unit	1：L
Set flow rate (digital)	0. 500 (L)

Set flow rate [significand]	2500
Flow rate decimal point position [number of decimal places]	1：1 digit
Flow rate unit	0：cc
Set flow rate	250. 0 (cc)