



Thermal Digital Mass Flow Controller

EX-201SC

**RS-485 Communications
Instruction Manual**

KOFLOC Corp.

Table of Contents

| | Page |
|---|------|
| 1. Foreword · · · · · | 2 |
| 2. Wire Connection · · · · · | 2 |
| 3. Basic Specifications · · · · · | 4 |
| 4. Message Structure · · · · · | 5 |
| 5. Details of Commands · · · · · | 7 |
| 1) RMFS : Acquisition of the <i>maximum full scale flow rate [significand]</i> · · · · · | 7 |
| 2) RDPP : Acquisition of the <i>flow rate decimal point position</i> <i>[number of decimal places]</i> · · · · · | 7 |
| 3) RFRU : Acquisition of the <i>flow rate unit</i> · · · · · | 7 |
| 4) RCFS : Acquisition of the <i>full scale flow rate [significand]</i> · · · · · | 7 |
| 5) RFRC : Acquisition of the <i>flow rate reference temperature condition</i> · · | 8 |
| 6) RRMD : Acquisition of the <i>motion mode</i> · · · · · | 8 |
| 7) WRMD : Setting of the <i>motion mode</i> · · · · · | 8 |
| 8) RPGT : Acquisition of the <i>calibration gas type</i> · · · · · | 9 |
| 9) RCGT : Acquisition of the <i>gas type</i> · · · · · | 9 |
| 10) RPCF : Acquisition of the <i>calibration gas CF value</i> · · · · · | 9 |
| 11) RCCF : Acquisition of the <i>CF value</i> · · · · · | 10 |
| 12) WCCF : Setting of the <i>CF value</i> · · · · · | 10 |
| 13) RRDP : Acquisition of the <i>motion differential pressure</i> · · · · · | 10 |
| 14) WRDP : Setting of the <i>motion differential pressure</i> · · · · · | 10 |
| 15) RCFR : Acquisition of the <i>instantaneous flow rate [significand]</i> · · · · | 11 |
| 16) RFSM : Acquisition of the <i>flow rate setting method</i> · · · · · | 11 |
| 17) WFSM : Setting of the <i>flow rate setting method</i> · · · · · | 11 |
| 18) RVSS : Acquisition of the <i>valve status (digital)</i> · · · · · | 11 |
| 19) WVSS : Setting of the <i>valve status (digital)</i> · · · · · | 11 |
| 20) RCVS : Acquisition of the <i>valve status</i> · · · · · | 12 |
| 21) RSFD : Acquisition of the <i>set flow rate [significand] (digital)</i> · · · · | 12 |
| 22) WSFD : Setting of the <i>set flow rate [significand] (digital)</i> · · · · | 12 |
| 23) RSFR : Acquisition of the <i>set flow rate [significand]</i> · · · · · | 12 |
| 24) RALM : Acquisition of the <i>alarm occurrence status</i> · · · · · | 13 |
| 25) RALA : Acquisition of the <i>response to alarm occurrence</i> · · · · · | 13 |
| 26) WALA : Setting of the <i>response to alarm occurrence</i> · · · · · | 13 |
| 27) RLFD : Acquisition of the <i>0 – 0.5% range flow rate indication</i> · · · · | 13 |
| 28) WLFD : Setting of the <i>0 – 0.5% range flow rate indication</i> · · · · | 14 |
| 29) RAZS : Acquisition of the <i>auto zero</i> · · · · · | 14 |
| 30) WAZS : Setting of the <i>auto zero</i> · · · · · | 14 |
| 31) RCVO : Acquisition of the <i>valve opening</i> · · · · · | 14 |
| 32) ZERO : Execution of sensor zero adjustment · · · · · | 14 |
| 6. Flow Rate Expression · · · · · | 15 |

1. Foreword

This document describes the specifications and handling of the RS-485 communications function installed as a standard feature in EX-201S.

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-201S 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.

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. 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 (0V) | Control (OPEN) | Fully open (+5~24V) |
| <i>The valve status (digital)</i> | 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 (0V) | Control (OPEN) | Fully open (+5~24V) |
| <i>The valve status (digital)</i> | Fully close (2) | Fully close | Fully close | Fully open |
| | Control (1) | | Controlled by the set flow rate [significant] (digital setting) | |
| | Fully open (0) | | Fully open | |

Flow rate setting method “Digital (0)”

3. Basic Specifications

| | |
|--------------------------|---|
| Synchronization | Start-stop |
| Transmission speed※ | 9,600 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 SW1 and 2 on top of equipment |

※ If there is a specific note in the OPTION column of the label attached to the main unit, it will be taken into consideration.

Using the switch SW1 and 2 on the top of the equipment, set a communication ID (01 – 99) 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 ASCII 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:

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

(STX) (Communication ID) (Command) (Data)(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 ASCII 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) RMFS : Acquisition of the *maximum full scale flow rate [significand]*

The *maximum full scale flow rate [significand]* is acquired.

The *maximum full scale flow rate [significand]* refers to the significand of the maximum full scale flow rate that this equipment has for the gas used for calibration of the equipment and is used to calculate the maximum full scale flow rate that the equipment has 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

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

The *full scale flow rate [significand]* is acquired.

The *full scale flow rate [significand]* refers to the significand of the full scale flow rate currently set to the equipment and 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

5) 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°C, 20 : 20°C, 25 : 25°C

6) RRMD : Acquisition of the *motion mode*

The *motion mode* that has been set is acquired.

This equipment has several motion modes.

Data Command: None
 Response: Decimal 1 digit (fixed length 1 byte)
 1 : Calibration gas mode
 2 : CF conversion mode
 4 : Multi-gas mode (DF-200 only)

7) WRMD : Setting of the *motion mode*

Set the *motion mode*.

Data Command: Decimal 1 digit (fixed length 1 byte)
 1 : Calibration gas mode
 2 : CF conversion mode
 Response : None

8) RPQT : 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 : N₂ (Nitrogen)

9) RCQT : Acquisition of the *gas type*

The *gas type* that has been set is acquired.

Data Command: None
 Response: Decimal 1 digit (fixed length 1 byte)
 0 : Unknown (Other than those below)
 1 : N₂ (Nitrogen)
 2 : AIR (Air)
 3 : H₂ (Hydrogen)
 4 : He (Helium)
 5 : Ar (Argon)
 6 : O₂ (Oxygen)
 7 : CO₂ (Carbon dioxide)
 8 : CH₄ (Methane)

10) RPCF : Acquisition of the *calibration gas CF value*

The *calibration gas CF value* is acquired.

The *calibration gas CF value* refers to the conversion factor of the gas used for equipment calibration based on N₂ (nitrogen) (1000).

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

1 1) RCCF : Acquisition of the *CF value*

The *CF value* that has been set is acquired.

The *CF value* is used for the CF conversion mode. This is expressed always based on N₂ (nitrogen) (1000) regardless of the *calibration gas types*.

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

1 2) WCCF : Setting of the *CF value*

Set the *CF value* used for the CF conversion mode. Set this always based on N₂ (nitrogen) (1000) regardless of the *calibration gas types*.

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

1 3) RRDP : Acquisition of the *motion differential pressure*

The *motion differential pressure* that has been set is acquired.

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

1 4) 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

1 5) 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: Decimal 4 digits (fixed length 4 bytes)
 Range: 0001 — 9999

1 6) RFSM : Acquisition of the *flow rate setting method*

The *flow rate setting method* that has been set is acquired.

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

1 7) 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

1 8) RVSS : Acquisition of the *valve status (digital)*

The *valve status (digital)* that has been set is acquired.

Data Command: None
 Response: Decimal 1 digit (fixed length 1 byte)
 0 : Fully opened, 1 : Controlled, 2 : Fully closed

1 9) WVSS : Setting of the *valve status (digital)*

Set the *valve status (digital)*.

Data Command: Decimal 1 digit (fixed length 1 byte)
 0 : Fully opened, 1 : Controlled, 2 : Fully closed
 Response: None

2 0) RCVS : Acquisition of the *valve status*

The present *valve status* is acquired.

Data Command: None

Response: Decimal 1 digit (fixed length 1 byte)

0 : Fully opened, 1 : Controlled, 2 : Fully closed, 3 : 50%opened

2 1) 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: 0001 — 9999

2 2) 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

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

The *set flow rate [significand]* that has been set 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*.

Data Command : Decimal 4 digits (fixed length 4 bytes)

Range: 0000 — 9999

Response: None

2 4) 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 (normal)

1 : Alarm present (Sensor error)

2 : Alarm present (valve overheat)

4 : Alarm present (set value storage circuit error)

When several alarms are present, their values are added.

2 5) 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, 3 : Valve forced to 50% opened

2 6) 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, 3 : Valve forced to 50% opened

Response: None

2 7) RLFD : Acquisition of the *0 – 0.5% range flow rate indication*

The *0 – 0.5% range flow rate indication* is acquired.

The *0 – 0.5% range flow rate indication* refers to the indication of data less than 0.5% of the instantaneous flow rate full scale.

Data Command: None

Response: Decimal 1 digit (fixed length 1 byte)

0 : 0 – 0.5% range flow rate indication used

1 : 0 – 0.5% range flow rate indication not used

(Forced indication of “0”)

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:

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

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

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

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

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