No. CP-SP-1176E

AUR450C
Flame Safeguard Control Dynamic Self Check Burner Controller
"Communications"
User's Manual

Thank you for purchasing the AUR450C Flame Safeguard Control Dynamic Self Check Burner Controller.

This manual contains information for ensuring the correct use the communication functions of the AUR450C.

Those who design and maintain devices that use the communication functions of the AUR450C should read this manual. It also provides necessary information for installation, maintenance, and troubleshooting. Be sure to keep this manual nearby for handy reference.

Yamatake Corporation

RESTRICTIONS ON USE

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment.

Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

IMPORTANT

- Do not use the communications output for control. The communications output of the AUR450C an output for monitor equipment status and combustion conditions.
- Do not dara write to write-inhibited addresses or to addresses having no description. Doing so may cause an error in communications or display.

NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact Yamatake Corporation.

In no event is Yamatake Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

SAFETY PRECAUTIONS

■ About Icons

The safety precautions described in this manual are indicated by various icons. Please be sure you read and understand the icons and their meanings described below before reading the rest of the manual.

Safety precautions are intended to ensure the safe and correct use of this product, to prevent injury to the operator and others, and to prevent damage to property. Be sure to observe these safety precautions.

⚠**WARNING**	Warnings are indicated when mishandling this product might result in death or serious injury.
⚠**CAUTION**	Cautions are indicated when mishandling this product might result in minor injury to the user, or only physical damage to the product.

■ Examples

	Triangles warn the user of a possible danger that may be caused by wrongful operation or misuse of this product. These icons graphically represent the actual danger. (The example on the left warns the user of the danger of electric shock.)
	White circles with a diagonal bar notify the user that specific actions are prohibited to prevent possible danger. These icons graphically represent the actual prohibited action. (The example on the left notifies the user that disassembly is prohibited.)
	Filled-in black circles instruct the user to carry out a specific obligatory action to prevent possible danger. These icons graphically represent the actual action to be carried out. (The example on the left instructs the user to remove the plug from the outlet.)

⚠WARNING

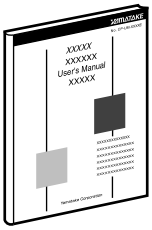
	**Before wiring the 400C/450C, be sure to turn the power OFF. Failure to do so may cause an electric shock.**
	**Do not touch terminal 1(F) of the main body immediately after the power has been turned OFF. Doing so may cause an electric shock. This terminal is electrically alive for 1 minute after the power to the device has been turned OFF.**

⚠CAUTION

	**After the wiring has been completed, check that it is correct. Incorrect wiring may cause damage or malfunction.**

The Role of This Manual

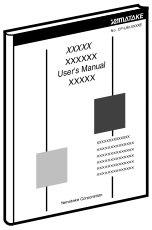
A total of five different manuals are available for the AUR450C. Read them as necessary for your specific requirements. If a manual you require is not available, contact Yamatake Corporation or its dealer.



AUR400C/450C Flame Safeguard Control Dynamic Self Check Burner Controller **Manual No. CP-SP-1196E**

This manual should be read by personnel using the AUR400C/450C for the first time, those in charge of designing combustion equipment that uses the AUR400C/450C or designing the hardware for mounting the device in a control panel, and personnel performing maintenance.

The manual gives an overview of the product, its mounting and wiring for connection to other equipment, its operation, trial-run adjustment, maintenance and inspection, and specifications.



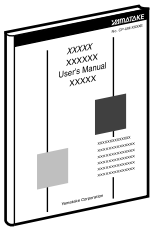
AUR450C Flame Safeguard Control Dynamic Self Check Burner Controller "Communications" **Manual No. CP-SP-1176E**

This manual.

Those using the communications functions of the AUR450C should read this manual.

It is necessary for making the program of the device that uses AUR450C. An operation status and various data of AUR450C can be read by using the communication.

This manual describes a details of display, outline of CPL communications, communications procedures, a list of communications data, how to remedy trouble, and communications specifications.

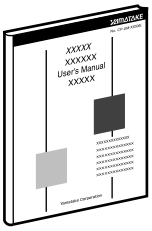


SLP-A45 Smart Loader Package for the AUR450C Flame Safeguard Control Dynamic Self Check Burner Controller **Manual No. CP-SP-1187E**

This manual is supplied with the SLP-A35/SLP-A45 Smart Loader Package.

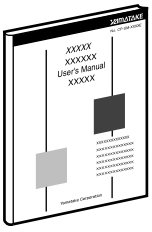
The manual describes the software used to make various settings for SLP-A45 using a personal computer. Personnel in charge of design or setting of a system using AUR450C must thoroughly read this manual.

The manual describes installation of the software into a personal computer, operation of the personal computer, various functions, and setup procedures.



AUD300C1000 Flame Safeguard Control Advanced UV Sensor **Manual No. CP-SP-1141E**

The manual describes the mounting, wiring, maintenance and inspection, and troubleshooting when the AUD300C1000 when it is used in a safeguard control system.



AUD300C2000 Flame Safeguard Control Advanced UV Sensor **Manual No. CP-SP-1170E**

The manual describes the mounting, wiring, maintenance and inspection, and troubleshooting when the AUD300C2000 when it is used in a safeguard control system.

Contents

Chapter 5. COMMUNICATIONS DATA

Chapter 6. FUNCTIONAL SETUP BY COMMUNICATIONS

Chapter 7. TROUBLESHOOTING

Chapter 8. SPECIFICATIONS

APPENDIX

Conventions Used in This Manual

The following conventions are used in this manual:

Handling Precautions:
Handling Precautions indicate items that the user should pay attention to when handling the AUR450C.

Note: Notes indicate information that might benefit the user.

☞: This indicates the item or page that the user is requested to refer to.

(1), (2), (3): Numbers within parentheses indicate steps in a sequence or parts of an explanation.

Chapter 1. OVERVIEW

Since the AUR450C is equipped with RS-485 communications capabilities, communications with a master station such as a PC or EST Smart Terminal are available using a user-prepared program. The communications protocol is CPL (Controller Peripheral Link: Yamatake's host communications protocol).
For example, with a PC as a master station, and with either RS-232C or RS-485, the AUR450C's operating status can be monitored or its data can be cleared using the CPL communications protocol.

■ Features

The AUR450C's communications functions include the following features:

- Up to 15 AUR450C units can be connected to a single master station acting as a master station. The CMC10B communications converter (sold separately) is necessary to connect 16 units or more.
- Connection to a master station having an RS-232C interface is also possible, using the CMC10L communications controller (sold separately). The CMC10L converts between RS-232C and RS-485 communications.
- Transmission speed up to 19200bps.
- Random access commands are available in addition to continuous access commands. Parameters at addresses separated by a single command can be read or written.

■ Communications functions

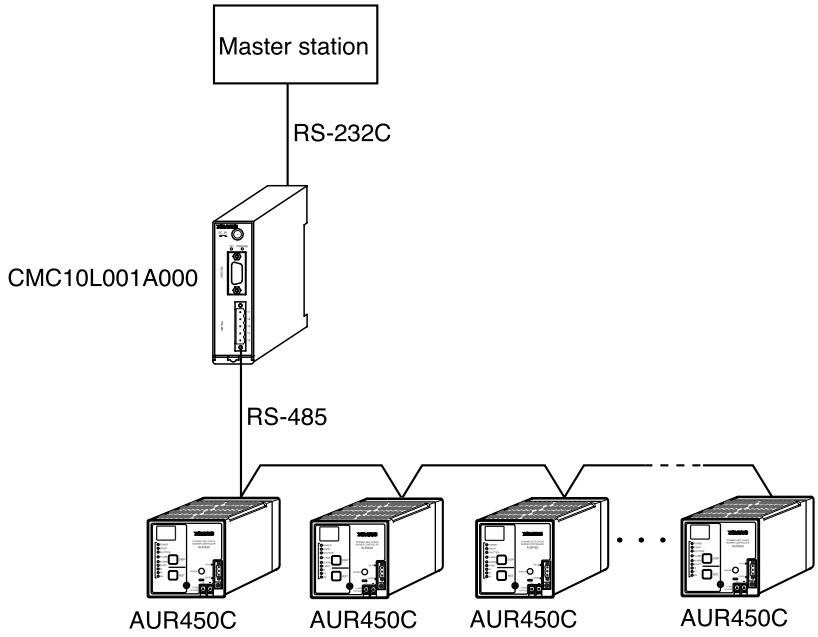
The AUR450C has 2 communications ports.
One is for host communications (RS-485) and the other is for loader communications.
Connect to the RS-485 connector on the front panel for host communications, and to the loader jack for loader communications.
Host communications are performed with fixed wiring of the equipment, and are used to monitor the operating status of multiple AUR450C units. Loader communications use a dedicated cable to connect with a PC.
Loader communications are useful for data analysis at the work site when equipment maintenance is performed.
This manual describes host communications.

In the RS-485 system, up to 15 units can be connected with one master station. The station address is used to identify ontroller for communication.

When the following procedure is completed during communication, various data for the controller can be read or written:

1. The master station transmits a request message to the slave station.
2. The master station receives a response message from the slave station.

- The commands from master station to slave station are classified into two types; read and write.
- The type of read/write data can be selected by data address.

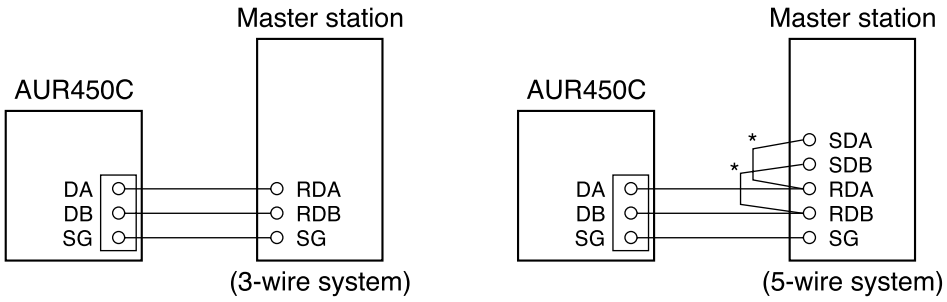


The CMC10L001A000 is Yamatake's RS-232C/RS-485 converter.

Chapter 2. WIRING

■ RS-485 connections

RS-485 communications use a 3-wire system.
Connect as follows using the RS-485 connector of the AUR450C:



Compatible connectors: Phoenix Contact
Model No. MSTB2.5/3-STF-5.08
Yamatake model No. 81446848-001 (1 unit)

IMPORTANT Terminating resistor

- Do not connect any terminating resistor to both ends of the transmission line. Doing so might cause the communication failure.
- Even though any units requiring the terminating resistor to exist in the transmossion line, do not connect any terminating resistor.

[!] Handling Precautions

- Use a twisted shielded pair cable for RS-485 communications.
- Ground shielded wire to one point on one side of the cable.
- Wire the connections marked with an asterisk (*) externally, when 5-wire system .

For connection method details, refer to;
☞AUR400C/450C Flame Safeguard Control Dynamic Self Check Burner Controller User's Manual, No. CP-SP-1196E.

■ Loader connections

When the Smart Loader Package (simply called "SLP" from here on) is used, connect from the loader jack of the AUR450C to a PC with the dedicated cable.

Note

- For SLP operation details, refer to:
  ☞SLP-A45 Smart Loader Package for the AUR450C Flame Safeguard Control Dynamic Self Check Burner Controller User's Manual, No.CP-SP-1187E.

Chapter 3. COMMUNICATIONS SETTINGS

The following settings are required for communications with the AUR450C:

1. Station address
2. Transmission speed
3. Data format

Each setting is described below.

The SLP is required in order to set transmission speed and data format.

! Handling Precautions

- After setting the station address, transmission speed and data format of the AUR450C, be sure to turn off its power supply once and then turn it on again. When the power is resupplied, the new station address, transmission speed and data format are in effect.

■ Station address

Using the ADDRESS switch on the front panel of the AUR450C, set to the desired station address.

Then turn off the power once, and turn it on again.

In determining a station address, be sure that the same number is not used twice on the same transmission line.

The setting range is 1 to F for 15 units.

! Handling Precautions

- The factory setting for the AUR450C station address is 0. When the station address is 0, communications functions do not operate. In order to use communications functions, be sure to set the station address.

■ Transmission speed

Set with the SLP.

The speed can be selected from 2400bps, 4800bps, 9600bps and 19200bps.

The factory setting is 19200bps.

■ Data format

Set with the SLP.

The data format can be selected from “8 bits, even parity, 1 stop bit” and “7 bits, no parity, 2 stop bit.”

The factory setting is 8 bits, even parity, 1 stop bit.

Chapter 4. COMMUNICATIONS

4 - 1 Outline of Communications

■ Communications procedures

The following is a simple breakdown of the communication procedure:

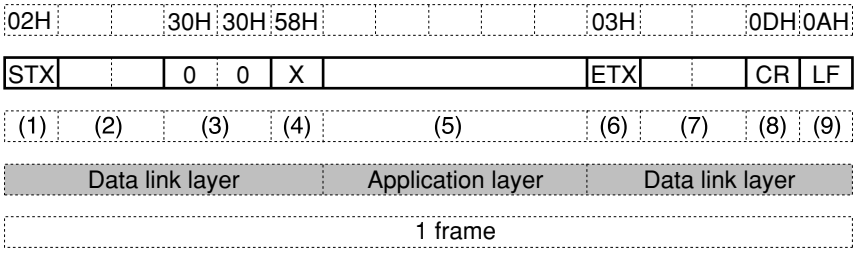
1. The master station transmits an instruction message to a slave station to specify a station for communication.
2. The slave station processes the instruction message, and executes read and write operations.
3. The slave station transmits a response message according to the contents of processing.
4. The master station receives the response message and executes processing.

■ Message structure

The following describes the message structure:
Messages are broadly classified into two layers: the data link layer and the application layer.

- Data link layer
  This layer contains the basic information required for communications, such as the destination of the instruction message and the checksum information for the message.
- Application layer
  Data is read and written in this layer. The content of the layer varies according to the purpose of the message.

Messages are composed of 9 parts from (1) to (9) as shown in the figure below. The command (details sent from the master station) and the response (details returned from the slave station) are stored in the application layer.



(1) STX (beginning of a message)
(2) Station address
(3) Sub-address (Fixed 00)
(4) Device code
(5) Instruction message=command Response message=response
(6) ETX(command/end of response)
(7) Checksum
(8) CR (delimiter)
(9) LF (delimiter)

■ Data link layer

● Outline

The data link layer has a fixed length. Generally the position of each data item and the number of its characters are fixed, but from ETX onwards the data positions shift according to the number of characters in the application layer.

● Response start conditions

The AUR450C (slave station) sends a response only when the message structures (station address, sub-address, checksum and message length of a single frame in the data link layer) are all correct. If even one of these is incorrect, the AUR450C does not send a response, and waits for new STX.

● List of data link layer data definitions

The following list shows the definitions for data in the data link layer:

Data name	Character code	Number of bytes	Description
STX	02H	1	Begining of message
Station address	Hexadecimal 00 to 0FH	2	Identification of device to communicate with
Sub-address	Displayed as hexadecimal character codes	2	Fixed at 00
Device code	"X" (58H) or "x" (78H)	1	Device type
ETX	03H	1	End of the application layer
Checksum	Displayed as 2-digit hexadecimal character codes from 00H to FFH	2	Checksum of message
CR	0DH	1	End of message (1)
LF	0AH	1	End of message (2)

● Description of data link layer

- STX(02H)

  When STX is received, the AUR450C concludes that an instruction message has begun. Therefore, it returns to the initial state from whatever reception state it was in, and processing is started taking STX as the first character received. The purpose of this is to enable the device to recover and respond to the next correct message (e.g. a RETRY message) from the master station in the event that noise, for example, causes an error in the previously sent message.

- Station address

  When the AUR450C receives instruction messages from the master station, it creates response messages only when the station addressed is itself. The station address in instruction messages is expressed as two-digit hexadecimal characters.

  The station address is set by the ADDRESS switch, which has a range of 0 to F. When connecting 16 units or more, the CMC10B communications controller (sold separately) is required.

  When the station address is set to 0 (30H 30H), the AUR450C does not respond even if the message is addressed to 30H 30H.

  When replying, the slave station returns to the same station address that was received.

- Sub-address

  The AUR450C does not use sub-address.

  For this reason, it returns "00" as the sub-address in response messages.

- Device code
  The device code is either X (58H) or x (78H). This code is fixed for each device series, so a different character cannot be used. When replying the AUR450C returns the same device code that was received. It may be convenient to use X (58H) first, and then use x (78H) to differentiate a resent message.
- ETX (03H)
  ETX indicates the end of the application layer.
- Checksum
  This value is for checking whether or not noise or other interference has changed the message content during communications. The checksum is expressed as a two-character hexadecimal number.

  - How to calculate a checksum
    (1) Add the character codes in the message from STX through ETX byte by byte.
    (2) Take the 2's complement of the low-order byte of the addition result.
    (3) Convert the obtained 2's complement to a two-byte ASCII code.

Example)
The sample message below is used to illustrate the calculation.
Station address: 10 (0AH)
Sub-address: 00 (fixed)
Device code: X (58H)

02H	30H	41H	30H	30H	58H	52H	53H	2CH	31H	30H	30H	31H	57H	2CH	32H	03H	38H	41H	0DH	0AH
STX	0	A	0	0	X	R	S	,	1	0	0	1	W	,	2	ETX	8	A	CR	LF

1. Add the character codes from STX to ETX byte by byte. The lower-order one byte of the calculation result is 76H.
2. The result of two's complement addition is 8AH.
3. Convert into character codes and use as the checksum value. The result is 8A (38H and 41H).

Handling Precautions

- Although the checksum of an instruction message can be omitted, in this case a checksum is not contained in the response. In order to ensure correct transmission of messages, do not omit the checksum.

- CR/LF
  This indicates the end of the message. After LF is received, the processing of the received message starts immediately.

■ Application layer

The table below shows the composition of the application layer.

Item	Description
Command	"RS" (Continuous data read command for decimal numerals)
	"WS" (Continuous data write command for decimal numerals)
	"RD" (Continuous data read command for hexadecimal numerals)
	"WD" (Continuous data write command for hexadecimal numerals)
	"RU" (Random data read command for hexadecimal numerals)
	"WU" (Random data write command for hexadecimal numerals)
Data delimiter	RS, WS: "," (comma) RD, WD, RU, WU: None
Word address	RS, WS: "501W", etc. RD, WD, RU, WU: "01F5", etc.
Read numeric data	Numeric characters expressed as "1" for example.
Write numeric data	RS, WS: Numeric characters expressed as "100" for example. RD, WD, RU, WU: Numeric characters expressed in hexadecimal as "0064" for example.

● Number of words accessible in a single frame

Type	Description of command	Number of words
RS	Read command for decimal numerals	16
WS	Write command for decimal numerals	16
RD	Read command for hexadecimal numerals	32
WD	Write command for hexadecimal numerals	32
RU	Random read command for hexadecimal numerals	16
WU	Random write command for hexadecimal numerals	16

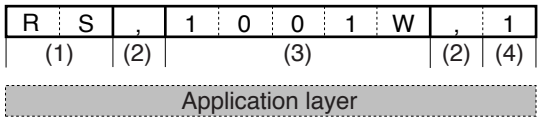
4 - 2 Description of Commands

■ Continuous data read command (RS command)

This command reads the content of continuous data addresses starting with the specified data start address. The address designation can be an actual address or a virtual address. This command reads the contents of continuous addresses in one message from a designated read data start address.

● Instruction message

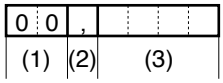
Example of reading the present sequence.



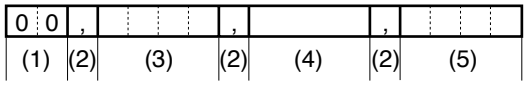
(1) Command
(2) Data delimiter
(3) Data start address
(4) Read data count

● Response message

• Normal (reading of single data item)



• Normal (reading of multiple data items)



• Error

The termination code (error) is entered at XX.

(1) Termination codes*
(2) Data delimiter
(3) Data item 1
(4) Data item 2 to (n-1)
(5) Data item (n)

*For details of termination codes, refer to:
☞ 4-4, "Termination Codes" (page 16).

● Maximum read data count in one message

16 words

■ Continuous data write command (WS command)

This command writes the content of continuous data addresses starting with the specified data start address.

● Instruction message

Example specifying a green light for flame voltage level of 3V and red light for 2V.

W	S	,	3	0	0	0	W	,	1	,	0	2
(1)		(2)	(3)					(2)	(4)	(2)	(5)	

(1) Command
(2) Data delimiter
(3) Write start address
(4) Write data (1st word)
(5) Write data (2nd word)

● Response message

• Normal

0	0
(1)	

• Error/alarm

X	X
(1)	

The termination code (error/alarm) is entered at XX.

(1) Termination codes*

*For details of termination codes, refer to:
☞ 4-4, "Termination Codes" (page 16).

● Maximum write data count in one message

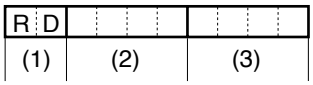
16 words

■ Fixed length continuous data read command (RD command)

RD is a command to read continuous data in two-byte units. It is suitable for handling data in ladder programs sent by PLC communications, as the data is of a fixed length. The data start address is expressed as a hexadecimal number of four characters ("digits"). The number of data items is also expressed as four digits, and data is expressed as 4n (n is a positive integer) hexadecimal digits.

● Instruction message

The read data start address (four hexadecimal digits) and the read data count (four hexadecimal digits) are sent.

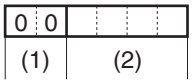


(1) Command□
(2) Data start address□
(3) Read data count

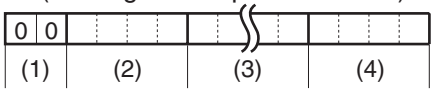
● Response message

If the message is received successfully, the normal termination code (two decimal digits) is returned along with the read data count (four hexadecimal digits times the number of items read) specified by the command. If the message was not received successfully, an abnormal termination code (two decimal digits) is returned without the read data appended.

• Normal (reading of single data item)



• Normal (reading of multiple data items)



• Error

The termination code (error) is entered at XX.

(1) Termination codes*
(2) Data item 1
(3) Data items 2 to (n-1)
(4) Data item n

*For details of codes, refer to:
☞ 4-4, "Termination Codes" (page 16).

● Maximum read data count in one message

32 words

■ Fixed length continuous data write command (WD command)

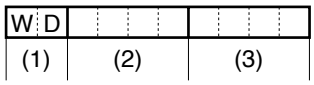
WD is a command to write continuous data in two-byte units. It is suitable for handling data in ladder programs sent by PLC communications as the data is of a fixed length. The data start address is expressed as four hexadecimal digits. The data is expressed as 4n (n is a positive integer) hexadecimal digits.

● Instruction message

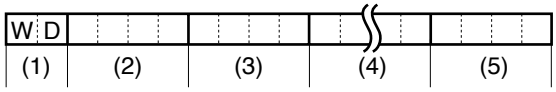
The write data start address (four hexadecimal digits) and the write data count (4n hexadecimal digits) are sent (n being the number of write data items).

● Response message

• Writing of a single data item



• Writing of multiple data items



(1) Command
(2) Data start address
(3) Data item 1
(4) Data items 2 to (n-1)
(5) Data item n

If writing is successful, the normal termination code (two decimal digits) is returned. If only a part of the data is written, a warning termination code (two decimal digits) is returned. If the data is not written at all, an abnormal termination code (two decimal digits) is returned.

• Normal

• Error/alarm

The termination code (error/alarm) is entered at XX.

(1) Termination codes*

*For details of codes, refer to:
☞ 4-4, "Termination Codes" (page 16).

● Maximum write data count in one message

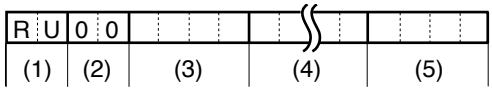
32 words

■ Fixed length random data read command (RU command)

This command reads random (non-continuous) data in two-byte units.

● Instruction message

The data addresses (four hexadecimal digits) of the data to be read are sent in the specified order.

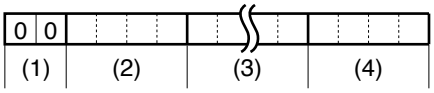


(1) Command
(2) Sub-command: fixed at 00.
(3) Data address 1
(4) Data addresses 2 to (n-1)
(5) Data address (n)

● Response message

If the message is received successfully, the normal termination code (two decimal digits) is returned along with the read data count (four hexadecimal digits times the number of data items) specified by the command. If the message was not received successfully, an abnormal termination code (two decimal digits) is returned without the read data appended.

• Normal



• Error

The termination code (error) is entered at XX.

(1) Termination codes*
(2) Data item 1
(3) Data items 2 to (n-1)
(4) Data item n

*For details of codes, refer to:
☞ 4-4, "Termination Codes" (page 16).

● Maximum read data count in one message

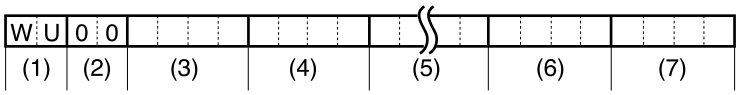
16 words

■ Fixed length random data write command (WU command)

This command writes data to random (non-continuous) addresses in two-byte units. Data is expressed as four hexadecimal digits.

● Instruction message

Data is sent such that the address (four hexadecimal digits) of the data to be written and the data (four hexadecimal digits) form a pair.



(1) Command
(2) Sub-command: fixed at 00
(3) Data address 1
(4) Write data 1
(5) Address/Write data 2 to (n-1)
(6) Address n
(7) Write data n

● Response message

If writing is successful, the normal termination code (two decimal digits) is returned. If only part of the data is written, and the remaining data is not written, a warning termination code (two decimal digits) is returned. If none of the data is written, an abnormal termination code (two decimal digits) is returned.

・Normal

・Error/alarm

The termination code (error/alarm) is entered at XX.

(1) Termination codes*

*For details of codes, refer to:
☞ 4-4, "Termination Codes" (page 16).

● Maximum write data count in one message

16 words

4 - 3 Numeric Representation in the Application Layer

Zero-suppressed representation is required for each numerical value.
Specifications, including the case that zero suppression is not applied, are given below. All instruction messages involving the master station must be transmitted with zero-suppressed data.

● **RS and WS commands**

Item	Specifications	Treatment of Abnormalities
Unnecessary space	Cannot be used.	Message processing is aborted and an abnormal termination code is returned as a response message.
Unnecessary zero	Cannot be used.	
Numerical value = zero	Cannot be omitted. Be sure to use "0"	
Other unnecessary characters	Numerical values may be prefixed with a "-" expressing a negative number. No other character may be used. The "+" sign must not be used to indicate positive numerical values.	
Range of available numerical values	-32768 to +32767. Values outside of this range are not allowed.	

● **RD, WD, RU and WU commands**

Item	Specifications	Treatment of Abnormalities
Unnecessary space	Cannot be used.	Message processing is aborted and an abnormal termination code is returned as a response message.
Unnecessary zero	Cannot be used.	
Numerical value = zero	Cannot be omitted. Be sure to use "0000"	
Other unnecessary characters	Cannot be used.	
Range of available numerical values	0000H to FFFFH	

4 - 4 Status Codes

The status code must be returned in a response message.

Status code	Type	Description	Treatment of Abnormalities	Example
00	Normal	Normal termination	All processing was completed normally.	
99	Error	Undefined command	Only the termination code is returned and message processing is not performed.	AA,1001W,1 RX03E80001
22	Alarm	The value of the written data is out of the specified range.	Processing continues except for the data address concerned	WS,2001W,3000
23	Alarm	Writing disabled due to instrument settings, instrument external conditions, etc.	Processing continues except for the data address concerned.	
40	Error	Read data count error	Only the termination code is returned and message processing is not performed.	RS,1001W,A RD03E9000Z
41	Error	• Data address is out of range. • Conversion error • Outside of the range of -32768 to +32767	Only the termination code is returned and message processing is not performed.	RS,100000W,1 WD0XXX0001
42	Alarm	• Value of data is out of range. • Data error • Data length exceeds one word.	Processing is performed up to the data address concerned; the succeeding processing is not performed.	WS,2001W,100,XXX WS,2001W,100000 WD03E900010XXX

4 - 5 Timing Specifications

■ Timing specifications for instruction message and response message

The obligatory instructions below concern the timing of instruction message transmission from the master station and response message transmission from the slave station.

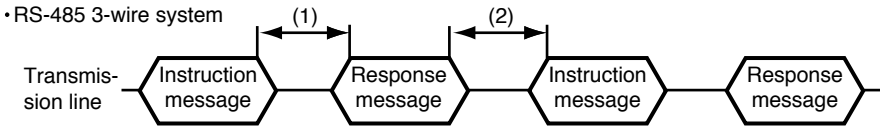
● Response monitor time

The maximum time between the end of the instruction message transmission by the master station and the start of reception of the response message from the slave station is two seconds [(1) in the figure below]. Therefore the response monitor time should be set to two seconds.

Resend the instruction message if a response time-out occurs.

● Transmission start time

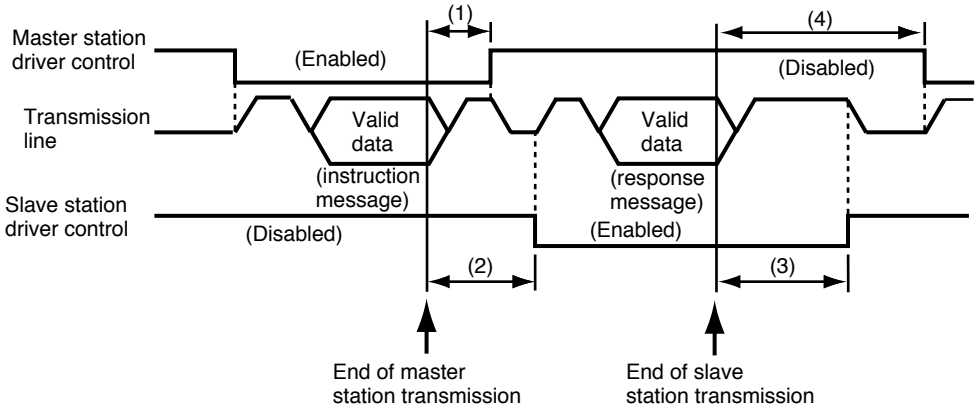
A wait time of 10ms is required before the master station starts to transmit the next instruction message (to the same slave station or a different slave station) after reception of a response message has ended [(2) in the figure below].



(1) End of master station transmission -
transmission start time of slave station = max. 2000ms
(2) End of slave station transmission -
transmission start time of master station = min. 10ms

■ RS-485 driver control timing specifications

When the transmission/reception on the RS-485 3-wire system is directly controlled by the master station, care should be paid to the following timing:



(1) End of master station transmission - time until driver disabled = max. 500µs
(2) End of slave station reception - time until driver enabled = min. 1ms
(3) End of slave station transmission - time until driver disabled = max. 10ms
(4) End of master station reception - time until driver enabled = min. 10ms

Chapter 5. COMMUNICATIONS DATA

■ Memory map (communications data table)

Data type	Item name	Address		Write	Data range	Initial value	Remarks
		Decimal	Hex.				
Maintenance data	Present sequence	1000W	03E8	X	0: Standby 1: Start check (P1) 2: Ignition trial (P2) 3: Pilot only (P3) 4: Main trial (P4) 5: RUN (P5) 6: Alarm	—	
	Alarm occurrence status	1001W	03E9	X	0: No alarm 1: Start check alarm (E0) 2: Interlock alarm (E1) 3: False flame (E2) 4: UV alarm (E3) 5: Ignition failure (E4) 6: Flame failure (E5)	—	
	Event occurrence status	1002W	03EA	X	Bit 0: Ignition delay (A1) Bit 1: Shutter cycle count upper setting value (A2) Bit 2: Shutter cycle count lower setting value (A3) Bit 3: Operation time upper setting value (A4) Bit 4: Combustion time upper setting value (A5) Bit 5: Combustion count upper setting value (A6) Bit 6: Flame voltage upper setting value (A7) Bit 7: Flame voltage lower setting value (A8)	—	
	Flame voltage	1003W	03EB	X	0 to 50	—	
	Flame voltage (maximum)	1004W	03EC	X	0 to 50	—	
	Flame voltage (minimum)	1005W	03ED	X	0 to 50	—	
	Average flame voltage (1s)	1006W	03EE	X	0 to 50	—	
	Average flame voltage (1min)	1007W	03EF	X	0 to 50	—	
	Shutter-open/closed cycle period	1016W	03F8	X	0 to 10000	—	
	Shutter-open time	1017W	03F9	X	0 to 5000	—	
	Shutter-closed time	1018W	03FA	X	0 to 5000	—	
	Shutter cycle count	1019W	03FB	X	0 to 255	—	
	Ignition delay time	1020W	03FC	X	0 to 100 999 (ignition failure)	—	
	Lockout occurrence status (bit)	1021W	03FD	X	Bit 0: Start check alarm Bit 1: Interlock alarm Bit 2: False flame Bit 3: UV alarm Bit 4: Ignition failure Bit 5: Flame failure Bit 6: Undefined Bit 7: Undefined	—	
Time/count data	Operation time (lower bytes)	1100W	044C	X	0 to 99999	—	◎
	Operation time (upper bytes)	1101W	044D	X			
	Combustion time (lower bytes)	1102W	044E	X	0 to 99999	—	◎
	Combustion time (upper bytes)	1103W	044F	X			
	Combustion count (lower bytes)	1104W	0450	X	0 to 99999	—	◎
	Combustion count (upper bytes)	1105W	0451	X			

Continue on next page.

Data type	Item name	Address		Write	Data range	Initial value	Remarks
		Decimal	Hex.				
Time/ count data	Operation time for event (lower bytes)	1106W	0452	X	0 to 99999	—	◎
	Operation time for event (upper bytes)	1107W	0453	X			
	Combustion time for event (lower bytes)	1108W	0454	X	0 to 99999	—	◎
	Combustion time for event (upper bytes)	1109W	0455	X			
	Combustion count for event (lower bytes)	1110W	0456	X	0 to 99999	—	◎
	Combustion count for event (upper bytes)	1111W	0457	X			
Alarm history data 1	Alarm code 1	2000W	07D0	X	0: No alarm 1: Start check alarm (E0) 2: Interlock alarm (E1) 3: False flame (E2) 4: UV alarm (E3) 5: Ignition failure (E4) 6: Flame failure (E5)	—	◎
	Sequence code when lockout occurs	2001W	07D1	X	0: No alarm 1: Start check (P1) 2: Ignition trial (P2) 3: Pilot only (P3) 4: Main trial (P4) 5: RUN (P5)	—	◎
	Operation time (lower bytes)	2002W	07D2	X	0 to 99999	—	◎
	Operation time (upper bytes)	2003W	07D3	X			
	Combustion time (lower bytes)	2004W	07D4	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2005W	07D5	X			
	Combustion count (lower bytes)	2006W	07D6	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2007W	07D7	X			
Alarm history data 2	Alarm code 2	2008W	07D8	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2009W	07D9	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2010W	07DA	X	0 to 99999	—	◎
	Operation time (upper bytes)	2011W	07DB	X			
	Combustion time (lower bytes)	2012W	07DC	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2013W	07DD	X			
	Combustion count (lower bytes)	2014W	07DE	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2015W	07DF	X			
Alarm history data 3	Alarm code 3	2016W	07E0	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2017W	07E1	X	Same as alarm history data 1	—	◎
	Operation time(lower bytes)	2018W	07E2	X	0 to 99999	—	◎
	Operation time (upper bytes)	2019W	07E3	X			
	Combustion time (lower bytes)	2020W	07E4	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2021W	07E5	X			
	Combustion count (lower bytes)	2022W	07E6	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2023W	07E7	X			

Continue on next page.

Data type	Item name	Address		Write	Data range	Initial value	Remarks
		Decimal	Hex.				
Alarm history data 4	Alarm code 4	2024W	07E8	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2025W	07E9	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2026W	07EA	X	0 to 99999	—	◎
	Operation time (upper bytes)	2027W	07EB	X			
	Combustion time (lower bytes)	2028W	07EC	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2029W	07ED	X			
	Combustion count (lower bytes)	2030W	07EE	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2031W	07EF	X			
Alarm history data 5	Alarm code 5	2032W	07F0	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2033W	07F1	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2034W	07F2	X	0 to 99999	—	◎
	Operation time (upper bytes)	2035W	07F3	X			
	Combustion time (lower bytes)	2036W	07F4	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2037W	07F5	X			
	Combustion count (lower bytes)	2038W	07F6	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2039W	07F7	X			
Alarm history data 6	Alarm code 6	2040W	07F8	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2041W	07F9	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2042W	07FA	X	0 to 99999	—	◎
	Operation time (upper bytes)	2043W	07FB	X			
	Combustion time (lower bytes)	2044W	07FC	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2045W	07FD	X			
	Combustion count (lower bytes)	2046W	07FE	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2047W	07FF	X			
Alarm history data 7	Alarm code 7	2048W	0800	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2049W	0801	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2050W	0802	X	0 to 99999	—	◎
	Operation time (upper bytes)	2051W	0803	X			
	Combustion time (lower bytes)	2052W	0804	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2053W	0805	X			
	Combustion count (lower bytes)	2054W	0806	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2055W	0807	X			
Alarm history data 8	Alarm code 8	2056W	0808	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2057W	0809	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2058W	080A	X	0 to 99999	—	◎
	Operation time (upper bytes)	2059W	080B	X			
	Combustion time (lower bytes)	2060W	080C	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2061W	080D	X			
	Combustion count (lower bytes)	2062W	080E	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2063W	080F	X			

Continue on next page.

Data type	Item name	Address		Write	Data range	Initial value	Remarks
		Decimal	Hex.				
Alarm history data 9	Alarm code 9	2064W	0810	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2065W	0811	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2066W	0812	X	0 to 99999	—	◎
	Operation time (upper bytes)	2067W	0813	X			
	Combustion time (lower bytes)	2068W	0814	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2069W	0815	X			
	Combustion count (lower bytes)	2070W	0816	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2071W	0817	X			
Alarm history data 10	Alarm code 10	2072W	0818	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2073W	0819	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2074W	081A	X	0 to 99999	—	◎
	Operation time (upper bytes)	2075W	081B	X			
	Combustion time (lower bytes)	2076W	081C	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2077W	081D	X			
	Combustion count (lower bytes)	2078W	081E	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2079W	081F	X			
Alarm history data 11	Alarm code 11	2080W	0820	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2081W	0821	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2082W	0822	X	0 to 99999	—	◎
	Operation time (upper bytes)	2083W	0823	X			
	Combustion time (lower bytes)	2084W	0824	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2085W	0825	X			
	Combustion count (lower bytes)	2086W	0826	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2087W	0827	X			
Alarm history data 12	Alarm code 12	2088W	0828	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2089W	0829	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2090W	082A	X	0 to 99999	—	◎
	Operation time (upper bytes)	2091W	082B	X			
	Combustion time (lower bytes)	2092W	082C	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2093W	082D	X			
	Combustion count (lower bytes)	2094W	082E	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2095W	082F	X			
Alarm history data 13	Alarm code 13	2096W	0830	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2097W	0831	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2098W	0832	X	0 to 99999	—	◎
	Operation time (upper bytes)	2099W	0833	X			
	Combustion time (lower bytes)	2100W	0834	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2101W	0835	X			
	Combustion count (lower bytes)	2102W	0836	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2103W	0837	X			

Continue on next page.

Data type	Item name	Address		Write	Data range	Initial value	Remarks
		Decimal	Hex.				
Alarm history data 14	Alarm code 14	2104W	0838	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2105W	0839	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2106W	083A	X	0 to 99999	—	◎
	Operation time (upper bytes)	2107W	083B	X			
	Combustion time (lower bytes)	2108W	083C	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2109W	083D	X			
	Combustion count (lower bytes)	2110W	083E	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2111W	083F	X			
Alarm history data 15	Alarm code 15	2112W	0840	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2113W	0841	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2114W	0842	X	0 to 99999	—	◎
	Operation time (upper bytes)	2115W	0843	X			
	Combustion time (lower bytes)	2116W	0844	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2117W	0845	X			
	Combustion count (lower bytes)	2118W	0846	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2119W	0847	X			
Alarm history data 16	Alarm code 16	2120W	0848	X	Same as alarm history data 1	—	◎
	Sequence code when lockout occurs	2121W	0849	X	Same as alarm history data 1	—	◎
	Operation time (lower bytes)	2122W	084A	X	0 to 99999	—	◎
	Operation time (upper bytes)	2123W	084B	X			
	Combustion time (lower bytes)	2124W	084C	X	0 to 99999	—	◎
	Combustion time (upper bytes)	2125W	084D	X			
	Combustion time (lower bytes)	2126W	084E	X	0 to 99999	—	◎
	Combustion count (upper bytes)	2127W	084F	X			
Alarm count	Start check alarm (E0) count	2500W	09C4	X	0 to 255	—	◎
	Interlock alarm (E1) count	2501W	09C5	X			◎
	False flame (E2) count	2502W	09C6	X			◎
	UV alarm (E3) count	2503W	09C7	X			◎
	Ignition failure (E4) count	2504W	09C8	X			◎
	Flame failure (E5) count	2505W	09C9	X			◎
Initiliza-tion	Event time/count initialization	3801W	0ED9	O	Operation time for event: A5C1 Combustion time for event: A5C2 Combustion count for event: A5C3 Operation time for event, combustion time for event, combustion count for event — initialize all: A5C4	—	
	Alarm history 1 to 16 initilization	3802W	0EDA	O	AC53	—	
	Alarm count initialization	3803W	0EDB	O	E0 (Start check alarm): AC51 E1 (Interlock alarm): AC52 E2 (False flame): AC53 E3 (UV alarm): AC54 E4 (Ignition failure): AC55 E5 (Flame failure): AC56 E0 to E5 — initialize all: AC59	—	

Continue on next page.

Data type	Item name	Address		Write	Data range	Initial value	Remarks
		Decimal	Hex.				
Event	Clear event	3804W	0EDC	O	Clear A1: CA51 Clear A2: CA52 Clear A3: CA53 Clear A4: CA54 Clear A5: CA55 Clear A6: CA56 Clear A7: CA57 Clear A8: CA58s Clear all from A1 to A8: CA59	—	
	Ignition delay	7040W	1B80	O	0: Unselected, 1: Selected	0	◎
	Shutter cycle count upper setting value	7041W	1B81	O	0: Unselected, 1: Selected	0	◎
	Shutter cycle count lower setting value	7042W	1B82	O	0: Unselected, 1: Selected	0	◎
	Operation time for event upper setting value	7043W	1B83	O	0: Unselected, 1: Selected	0	◎
	Combustion time for event upper setting value	7044W	1B84	O	0: Unselected, 1: Selected	0	◎
	Combustion count for event upper setting value	7045W	1B85	O	0: Unselected, 1: Selected	0	◎
	Flame voltage upper setting value	7046W	1B86	O	0: Unselected, 1: Selected	0	◎
	Flame voltage lower setting value	7047W	1B87	O	0: Unselected, 1: Selected	0	◎
	Ignition delay time setting	7048W	1B88	O	0 to 100	100	◎
	Shutter cycle count upper setting value	7049W	1B89	O	0 to 255	255	◎
	Shutter cycle count lower setting value	7050W	1B8A	O	0 to 255	0	◎
	Operation time for event upper setting value (lower bytes) *	7051W	1B8B	O	0 to 99999	25000	◎
	Operation time for event upper setting value (upper bytes) *	7052W	1B8C	O			
	Combustion time for event upper setting value (lower bytes) *	7053W	1B8D	O	0 to 99999	25000	◎
	Combustion time for event upper setting value (upper bytes) *	7054W	1B8E	O			
	Combustion count for event upper setting value (lower bytes)	7055W	1B8F	O	0 to 99999	99999	◎
	Combustion count for event upper setting value (upper bytes)	7056W	1B90	O			
	Flame voltage upper setting value time	7057W	1B91	O	0 to 255	255	◎
	Flame voltage upper setting value	7058W	1B92	O	0 to 50	50	◎
	Flame voltage lower setting value time	7059W	1B93	O	0 to 255	255	◎
	Flame voltage lower setting value	7060W	1B94	O	0 to 50	0	◎
FLAME LED	Green FLAME LED light level	7070W	1B9E	O	0 to 50	25	◎
	Red FLAME LED light level	7071W	1B9F	O	0 to 50	15	◎

Continue on next page.

Data type	Item name	Address		Write	Data range	Initial value	Remarks
		Decimal	Hex.				
RS-485 communi-cations settings	Data format	8000W	1F40	O	0: Data length 8 bits, even parity, 1 stop bit 1: Data length 7 bits, no parity, 2 stop bits	0	Set with the SLP ◎
	Transmission speed	8001W	1F41	O	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps	3	Set with the SLP ◎
AUR memo	AUR memo and tab	8100W	1FA4	O		—	◎
		↓	↓	↓		↓	↓
		8159W	1FDF	O		—	◎

◎ in the Remarks column denotes the data for backup.
O in the Write column means that writing from an external device is possible.
X means that writing from an external device is not possible.
* indicates that the WU command should be used when writing data.

Handling Precautions

- Data written to 7000W level addresses and 8000W level addresses is saved in EEPROM. The number of times that EEPROM can be rewritten is limited (100,000 operations). Accordingly, do not rewrite frequently.

● Writing data range

If the data to be written exceeds the range determined by parameters, it is not written, and an abnormal termination code is returned.

● Writing conditions

An abnormal termination code is also returned when writing is not performed for other reasons.

■ Data backup

Data is saved to EEPROM.
Updating of data to EEPROM is performed in the following cases:

- When lockout occurs
- After every hour of operation
- When setup is changed by communications.

Data that is less than one hour old is maintained by a backup capacitor.

Handling Precautions

- If the backup time (4 to 12 hours under normal temperature and humidity) is exceeded, operation time or combustion time data less than one hour old may be lost.
- When the backup time is exceeded, combustion count data that has not been saved to EEPROM may be lost.
- When it is necessary to clear trial operation data before delivering the equipment to the user, clear the trial data first and then store the formal operation data.

Chapter 6. FUNCTIONAL SETUP BY COMMUNICATIONS

6 - 1 Monitor Functions

■ Maintenance data

Maintenance data in the table below is stored in internal memory.
The details can be checked by reading out the data at maintenance/check or when lockout occurs.

Item	Address	Data range	Remarks
Present sequence	1000W	0: Standby (--) 1: Start check (P1) 2: Ignition trial (P2) 3: Pilot only (P3) 4: Main trial (P4) 5: RUN (P5) 6: Alarm	Present sequence code
Alarm occurrence status	1001W	0: No alarm 1: Start check alarm (E0) 2: Interlock alarm (E1) 3: False flame (E2) 4: UV alarm (E3) 5: Ignition failure (E4) 6: Flame failure (E5)	Present alarm code
Event occurrence status	1002W	Bit 0: Ignition delay (A1) Bit 1: Shutter cycle count upper setting value (A2) Bit 2: Shutter cycle count lower setting value (A3) Bit 3: Operation time upper setting value (A4) Bit 4: Combustion time upper setting value (A5) Bit 5: Combustion count upper setting value (A6) Bit 6: Flame voltage upper setting value (A7) Bit 7: Flame voltage lower setting value (A8)	Present event occurrence status. When there is no event, all bits are OFF.
Flame voltage	1003W	0 to 50 (0.0 to 5.0V)	Present flame voltage
Flame voltage (max.) [*1]	1004W	0 to 50 (0.0 to 5.0V)	Maximum flame voltage.Data is automatically updated every 5 seconds.
Flame voltage (min.) [*1]	1005W	0 to 50 (0.0 to 5.0V)	Minimum flame voltage. Data is automatically updated every 5 seconds.
Average flame voltage (1s)	1006W	0 to 50 (0.0 to 5.0V)	Average flame voltage for 1 second. Data is automatically updated every 1 second.
Average flame voltage (1min)	1007W	0 to 50 (0.0 to 5.0V)	Moving-average flame voltage for 1 minute.
Shutter-open/closed cycle period	1016W	0 to 10000 (0.000 to 10.000 seconds)	Shutter-open/closed total time
Shutter-open time	1017W	0 to 5000 (0.000 to 5.000 seconds)	Shutter-open time. Time counting stops at 5000 after 5 seconds elapse while the shutter is open.
Shutter-closed time	1018W	0 to 5000 (0.000 to 5.000 seconds)	Shutter-closed time. Time counting stops at 5000 after 5 seconds elapse while the shutter is closed.

Continue on next page.

Item	Address	Data range	Remarks
Average flame voltage (1min)	1019W	0 to 255 (0 to 255 times)	Shutter cycle count. Data is automatically updated every 1 second.
Ignition delay time [*2]	1020W	0 to 100 (0 to 10.0 seconds) 999 (ignition failure)	Time from ignition trial start to ignition detection.
Lockout occurrence status	1021W	Bit 0: Start check alarm Bit 1: Interlock alarm Bit 2: False flame Bit 3: UV alarm Bit 4: Ignition failure Bit 5: Flame failure Bit 6: Undefined Bit 7: Undefined	Present alarm occurrence status. When there is no alarm, all bits are OFF.

*1 The maximum and minimum value calculations are based on average flame voltage for 1s.
The values within parentheses ( ) are in the actual unit.

*2 Ignition delay data is as shown below:

Status	Data
Ignition failure	999
Start contact is OFF during ignition trial operation.	0
Interlock is OFF during ignition trial operation, resulting in lockout.	0

Data is cleared at startup and changed to 0.

■ Time/count data

Time data and operation count data for the items shown in the table below are collected and recorded. Time/count is shown in 2 words.

Item	Address	Data range	Remarks
Operation time	1100W 1101W	0 to 99999h	Cumulative ON time
Combustion time	1102W 1103W	0 to 99999h	Cumulative RUN time
Combustion count	1104W 1105W	0 to 99999 times	Cumulative RUN count
Operation time (for event)*	1106W 1107W	0 to 99999h	ON time
Combustion time (for event)*	1108W 1109W	0 to 99999h	RUN time
Combustion count (for event)*	1110W 1111W	0 to 99999 times	RUN count

* Data for events is cleared to 0 at event clear.

For example, an operation time of 76,543 is stored as shown below.

Operation time	Hexadecimal	Upper bytes (1101W)	Lower bytes (1100W)
76543	12AFF	1h (1)	2AFFh (11007)

Numbers in parentheses ( ) are decimal numbers.

■ Alarm history data

When an alarm occurs, the data below is recorded in internal memory as alarm history data.
Data for the past 16 alarm occurrences, including the latest lockout data, is recorded.
Addresses are 2000W to 2127W. Each piece of alarm data is structured as 8 continuous "words." Alarm history time/count data consists of 2 words, like the time/count data of the previous item. The lower number of the address shows the lower bytes.

Item	Data range	Remarks
Alarm code	0: No alarm 1: Start check alarm (E0) 2: Interlock alarm (E1) 3: False flame (E2) 4: UV alarm (E3) 5: Ignition failure (E4) 6: Flame failure (E5)	
Sequence code on lockout	0: No alarm 1: Start check (P1) 2: Ignition trial (P2) 3: Pilot only (P3) 4: Main trial (P4) 5: RUN (P5)	
Operation time	0 to 99999h	2-word data
Combustion time	0 to 99999h	2-word data
Combustion count	0 to 99999 times	2-word data

⚠ Handling Precautions

- When more than 16 alarms have occurred, the oldest alarm history data is deleted.
- If the data items from the alarm code to the combustion count all have a value of 0, the alarm history data has not yet been set up.

The relationship between alarm occurrence order and address is shown below.

Alarm occurrence order	Address
Alarm (1) (latest)	2000W to 2007W
Alarm (2)	2008W to 2015W
Alarm (3)	2016W to 2023W
Alarm (4)	2024W to 2031W
Alarm (5)	2032W to 2039W
Alarm (6)	2040W to 2047W
Alarm (7)	2048W to 2055W
Alarm (8)	2056W to 2063W
Alarm (9)	2064W to 2071W
Alarm (10)	2072W to 2079W
Alarm (11)	2080W to 2087W
Alarm (12)	2088W to 2095W
Alarm (13)	2096W to 2103W
Alarm (14)	2104W to 2111W
Alarm (15)	2112W to 2119W
Alarm (16)	2120W to 2127W

2000W	Alarm code
2001W	Sequence code on lockout
2002W	Operation time (lower bytes)
2003W	Operation time (upper bytes)
2004W	Operation time (lower bytes)
2005W	Operation time (upper bytes)
2006W	Operation time (lower bytes)
2007W	Operation time (upper bytes)

■ Alarm count

A count of each type of alarm is stored in internal memory.
Up to 255 occurrences are recorded for each.

Item	Address	Data range	Remarks
Start check alarm (E0) count	2500W	0 to 255	Count of up to 255 alarm ocurrences. Alarms occurrences over 255 are not recorded.
Interlock alarm (E1) count	2501W	0 to 255	
False flame (E2) count	2502W	0 to 255	
UV alarm (E3) count	2503W	0 to 255	
Ignition failure (E4) count	2504W	0 to 255	
Flame failure (E5) count	2505W	0 to 255	

■ AUR memo

Up to 120 ASCII characters, or 60 characters (2-byte code) can be recorded.
Addresses are the 60-words from 8100W to 8159W.

6 - 2 Event Functions

■ Event item

The items below can be handled as events on the AUR450C.

Event item	Event No.	Summary
Ignition delay	A1	The time from ignition trial start to flame detection is measured as ignition delay time. When it exceeds the set value, an event occurs.
Shutter cycle count upper setting value	A2	When the shutter cycle count exceeds the set value, an event occurs.
Shutter cycle count lower setting value	A3	When the shutter cycle count drops below the set value, an event occurs.
Operation time for event upper setting value	A4	When the AUR450C operation time exceeds the set value, an event occurs.
Combustion time for event setting value	A5	When the AUR450C combustion time exceeds the set value, an event upper occurs.
Combustion count for event upper setting value	A6	When the AUR450C combustion count exceeds the set value, an event occurs.
Flame voltage upper setting value	A7	When the AUR450C flame voltage has exceeded the set value during RUN, and the response time has elapsed, an event occurs.
Flame voltage lower setting value	A8	When AUR450C flame voltage has dropped below the set value during RUN, and the response time has elapsed, an event occurs.

■ Using an event

The three steps below are required for an event function to operate.

(1) Select the event for use.
Determine the event for use from selection addresses 7040W to 7047W. When "1" is written to an event selection address, the event can be selected. (All items can also be selected as events.) Since the factory setting is "0" (unselected), all events are initially unavailable.

(2) Set the event conditions.
The setting of conditions for each event is performed at addresses 7048W to 7060W. Choose the numeric value that will trigger the event, and write it to the condition setting address.

[!] Handling Precautions

- Be sure to select the event in selection addresses 7040W to 7047W as described above in item (1). Writing a value to the condition setting address alone is not sufficient for the event to occur.

(3) Event occurrence
When the conditions previously determined and set in item (2) are satisfied, the event occurs.
When the event occurs, the EVENT LED lights up, and the relevant event occurrence status bit (in 1002W) of the communications data is changed to "1." In addition, if the DISP switch is pressed when the EVENT LED is lit, the event code is displayed on the 7-segment display.

[!] Handling Precautions

- When the EVENT LED lights up while an alarm also occurs, the event code cannot be displayed by pressing the DISP switch.
- When some events occur, the display shows event codes automatically in turn.
- An event, once it has occurred, will be held until it is cleared.

■ Details on event items

● Ignition delay (A1)

The AUR450C measures ignition delay time from begining the ignition trial time to flame detection (K6 ON). When the ignition delay time exceeds the ignition delay time setting limit, an event occurs. However, an event cannot be set for the following cases:

- Ignition failure
- Error during ignition trial (interlock error, etc.)
- The start contact OFF during ignition trial

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7040W	Ignition delay	0: Unselected 1: Selected	0	7048W, 1020W are enable when 1:selected.
Condition setting	7048W	Ignition delay time setting	0 to 100	100	(10.0s)
Measurement data	1020W	Ignition delay time	0 to 100	-	999 (Ignition failure)

The factory setting number in parentheses ( ) is expressed in the actual data unit.

● Shutter cycle count upper setting value (A2)

The AUR450C measures the number of shutter cycles per minute. When this shutter cycle count exceeds the shutter cycle count upper setting value during combustion (operating sequence RUN), an event occurs. However, after beginning RUN, the conditions for events are not judged for 2 minutes.

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7041W	Shutter cycle count upper setting value	0: Unselected 1: Selected	0	7049W, 1019W are enable when 1:selected.
Condition setting	7049W	Shutter cycle count upper setting value	0 to 255	255	(255 times)
Measurement data	1019W	Shutter cycle count	0 to 255	-	

The factory setting number in parentheses ( ) is expressed in the actual data unit.

● Shutter cycle count lower setting value (A3)

The AUR450C measures the number of shutter cycles per minute. When this shutter cycle count drops below the shutter cycle count lower setting value during the RUN period, an event occurs. However, after beginning RUN, the conditions for events are not judged for 2 minutes.

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7042W	Shutter cycle count lower setting value	0: Unselected 1: Selected	0	7050W, 1019W are enable when 1:selected.
Condition setting	7050W	Shutter cycle count lower setting value	0 to 255	0	(0 time)
Measurement data	1019W	Shutter cycle count	0 to 255	-	

The factory setting number in parentheses ( ) is expressed in the actual data unit.

● Operation time for event upper setting value (A4)

The operating time of the AUR450C is measured as operation time for event. When operation time for event exceeds the operation time for event setting value, an event occurs.

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7043W	Operation time for event upper setting value	0: Unselected 1: Selected	0	7051W, 7052W, 1106W, 1107W are enable when 1:selected.
Condition setting	7051W	Operation time for event upper setting value (lower bytes)	0 to 99999	25000	
	7052W	Operation time for event upper setting value (upper bytes)			
Measurement data	1106W	Operation time for event (lower bytes)	0 to 99999	-	
	1107W	Operation time for event (upper bytes)			

Handling Precautions

• Use the WU command to write this data.

For example, the setup for an operation time for event upper setting value of 76,543 hours is as follows:

Operation time for event upper setting value	Hexadecimal	Upper bytes (7052W)	Lower bytes (7051W)
76543	12AFF	1h (1)	2AFFh (11007)

The decimal equivalent is in parentheses ( ).

● Combustion time for event upper setting value (A5)

The combustion (RUN) time of the AUR450C is measured as combustion time for event. When combustion time for event exceeds the combustion time for event setting value, an event occurs.

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7044W	Combustion time for events upper setting value	0: Unselected 1: Selected	0	7053W, 7054W, 1108W, 1109W are enable when 1:selected.
Condition setting	7053W	Combustion time for event upper setting value (lower bytes)	0 to 99999	25000	(25000 h)
	7054W	Combustion time for event upper setting value (upper bytes)			
Measurement data	1108W	Combustion time for event (lower bytes)	0 to 99999	-	
	1109W	Combustion time for event (upper bytes)			

The factory setting number in parentheses ( ) is expressed in the actual data unit.

Handling Precautions

• Use the WU command to write this data.

For example, the combustion time for event upper setting value can be set to 76,543 hours as follows:

Combustion time for event upper setting value	Hexadecimal	Upper bytes (7052W)	Lower bytes (7051W)
76543	12AFF	1h (1)	2AFFh (11007)

The decimal equivalent is in parentheses ( ).

● Combustion count for event upper setting value (A6)

The combustion count (number of RUN operations) for the AUR450C is measured as combustion count for event. When combustion count for event exceeds the combustion count for event upper setting value, an event occurs.

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7045W	Combustion count for event upper setting value	0: Unselected 1: Selected	0	7055W, 7056W, 1110W, 1111W are enable when 1:selected.
Condition setting	7055W	Combustion count for event upper setting value (lower bytes)	0 to 99999	99999	
	7056W	Combustion count for event upper setting value (upper bytes)			
Measurement data	1110W	Combustion count for event (lower bytes)	0 to 99999	-	
	1111W	Combustion count for event (upper bytes)			

The factory setting number in parentheses ( ) is expressed in the actual data unit.

● Flame voltage upper setting value (A7)

The AUR450C measures flame voltage and averages it a second. If this flame voltage exceeds the flame voltage upper setting value during the RUN piriod, and if the flame voltage response time upper setting value has elapsed, an event occurs.

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7046W	Flame voltage upper setting value	0: Unselected 1: Selected	0	7057W, 7058W, 1006W are enable when 1:selected.
Condition setting	7057W	Flame voltage upper setting value time	0 to 255	255	
	7058W	Flame voltage upper setting value	0 to 50	50	
Measurement data	1006W	Average flame voltage (1s)	0 to 50	-	

The factory setting number in parentheses ( ) is expressed in the actual data unit.

● Flame voltage lower setting value (A8)

The AUR450C measures flame voltage and averages it a second. If this flame voltage below the flame voltage lower setting value during the RUN period, and if the flame voltage response time lower setting value has elapsed, an event occurs.

Item	Address	Content	Data range	Factory setting	Remarks
Selection	7047W	Flame voltage lower setting value	0: Unselected 1: Selected	0	7059W, 7060W, 1006W are enable when 1:selected.
Condition setting	7059W	Flame voltage lower setting value time	0 to 255	255	
	7060W	Flame voltage lower setting value	0 to 50	0	
Measurement data	1006W	Average flame voltage (1s)	0 to 50	-	

■ Clearing an event

There are two methods to clear an event that has occurred.

- One is to clear with a communications command.
- The other is to press and hold the DISP switch.

● Clearing by communications reset

To clear an event by communications command, write the following data to 3804W using the WD command or WU command:

Item	Address	Event description	Data to write
Clear event	3804W	Ignition delay (A1)	CA51
		Shutter cycle count upper setting value (A2) [*1]	CA52
		Shutter cycle count lower setting value (A3) [*1]	CA53
		Operation time upper setting value (A4) [*2]	CA54
		Combustion time upper setting value (A5) [*3]	CA55
		Combustion count upper setting value (A6) [*4]	CA56
		Flame voltage upper setting value (A7)	CA57
		Flame voltage lower setting value (A8)	CA58
		All clear event	CA59

*1: After the event has been cleared and 2 minutes have elapsed, the evaluation of event conditions resumes for shutter cycle count upper setting value and shutter cycle count lower setting value.

*2: After the event has been cleared, the operation time for event (1106W/1107W) is cleared to 0.

*3: After the event has been cleared, the combustion time for event (1108W/1109W) is cleared to 0.

*4: After the event has been cleared, the combustion count for event (1110W/1111W) is cleared to 0.

For example, if “CA51” is written to 3804W, the ignition delay (A1) is cleared. Other events occurring at the same time will not be cleared. To clear all events collectively, write “CA59.”

Handling Precautions

- If all events are cleared collectively, the EVENT LED turns off and the 7-segment display changes to the sequence code display mode.

● Clearing by DISP switch

When the DISP switch is pressed and held for 2 seconds or more while an event code is displayed, all events can be cleared collectively.

After events have been cleared and 2 minutes have elapsed, the evaluation of event conditions resumes for shutter cycle count upper setting value and shutter cycle count lower setting value. In addition, operation time for event (1106W/1107W), combustion time for event (1108W/1109W) and combustion count for event (1110W/1111W) are cleared to 0.

Handling Precautions

- When an event is cleared by this method, the EVENT LED turns off and the 7-segment display changes to the sequence code display mode.

6 - 3 FLAME LED Setup

The FLAME LED can be set to change color in the sequence green → orange → red → OFF corresponding to descending flame voltage levels.
If no flame is detected (K6 relay OFF), the LED is OFF.

Item	LED color	Address	Factory setting	Flame voltage level
FLAME LED	Green	7070W	25 (2.5Vdc)	2.5V or more
	Orange	—	—	1.6 to 2.4V
	Red	7071W	15 (1.5Vdc)	1.5V or less

Handling Precautions

- Be sure to set the LED in such a way that red level < green level.

6 - 4 Data initialization

Data can be initialized by writing the following data strings using the WD command or WU command:
For example, if “A5C4” is written to 3801W, all the operation/combustion times and counts are cleared to 0.

Item	Address	Description		Data to write
Time/count initialization	3801W	Operation time for event	(1106W,1107W)	A5C1
		Combustion time for event	(1108W,1109W)	A5C2
		Combustion count for event	(1110W,1111W)	A5C3
		Initialize all	(1106W to 1111W)	A5C4
Alarm history initialization	3802W	Alarm (1) to Alarm (16)	(2000W to 2127W)	AC53
Alarm count initialization	3803W	Start check alarm (E0)	(2500W)	AC51
		Interlock alarm (E1)	(2501W)	AC52
		False flame (E2)	(2502W)	AC53
		UV alarm (E3)	(2503W)	AC54
		Ignition failure (E4)	(2504W)	AC55
		Flame failure (E5)	(2505W)	AC56
		Initialize all	(2500 to 2505W)	AC59

Chapter 7. TROUBLESHOOTING

■ Items to check if there is a communications error

1. Is the RS-485 wiring wrong?
2. Are the communications settings the same for the master station and the AUR450C?
   If any of the following settings are different, communications are not possible:

Transmission speed:	1200, 2400, 4800, 9600, 19200bps
Data length:	8 bits
Parity:	no parity, even parity
Stop bit:	1 bit, 2 bits

3. Does the station address in the instruction message from the master station match the address which is set for the AUR450C?
   The factory setting for the station address of the AUR450C is 0.
   If the station address is 0, communications functions do not operate. Even if the station address of instruction message is set to 00 (30H, 30H), the AUR450C will not respond.
4. Use capital letters for all the character codes except for the device code (in case of the AUR450C, "X" or "x").

⚠ Handling Precautions

- Once the station address has been set with the [ADDRESS] switch, it takes effect after the power supply is turned off and then on again. If the power is not turned off and then on, the new setting will not be reflected.

Chapter 8. SPECIFICATIONS

■ RS-485 specifications

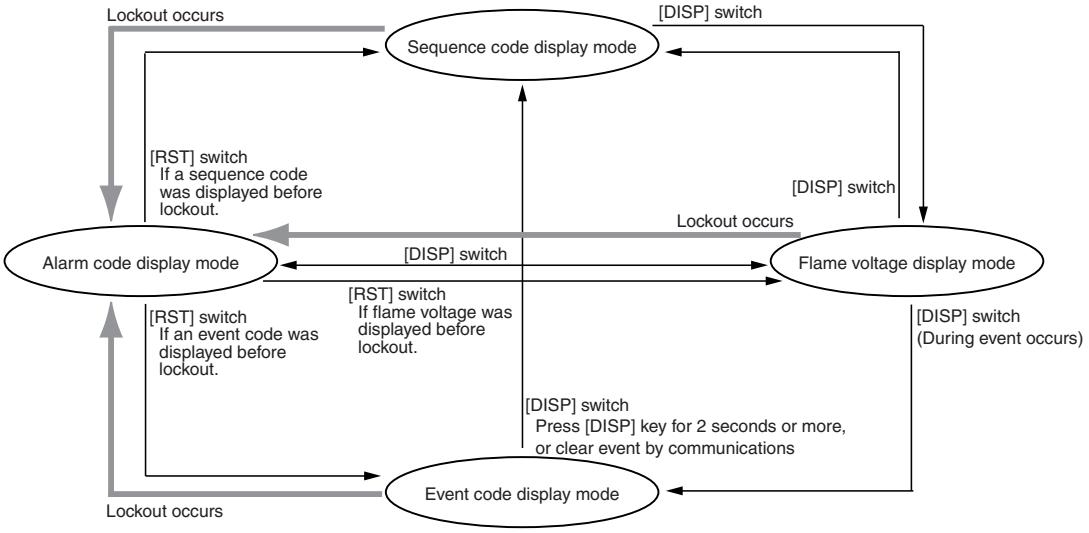
Item	Specifications
Transmission mode	Balanced
Transmission line	3-wire system
Transmission speed (bps)	1200, 2400, 4800, 9600, 19200
Transmission distance	500m max.
Communication system	Half duplex
Synchronization	Start-stop synchronization
Data format	Data 8 bits 1 stop bit even parity Data 8 bits 2 stop bits no parity
Error detection	Parity check
Station address	0 to F (in case of 0, communications functions are disabled)
Connection method	1:N (Units 15 max.)
Terminating resistor	Connection prohibited (resistor already built-in)
Other	RS-485 compliant

APPENDIX

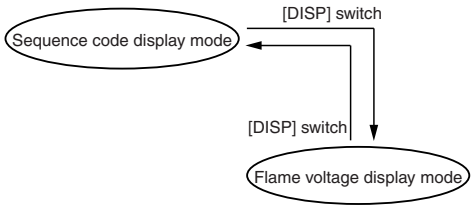
This APPENDIX describes the display details and basic operations of the AUR450C so that they can be easily understood without reading the AUR450C user's manual (CP-SP-1196E).

■ Display mode transitions

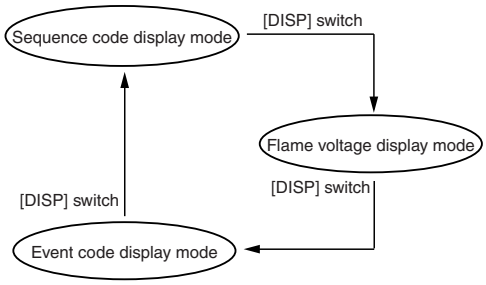
The AUR450C has a 7-segment display and LED displays.
The 7-segment display uses 2 digits to show sequence code, alarm code, event code and flame voltage. Each display mode and state transition is shown below.



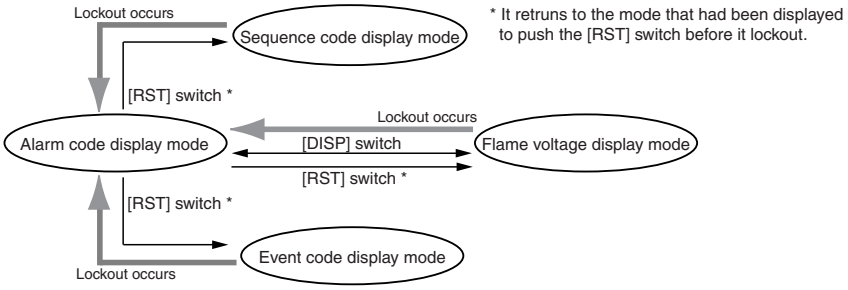
• When normal (event/lockout not occurs)



• When event occurs



• When lockout occurs



Display details of each mode are on next page.

■ Display functions

● Sequence code display mode

In sequence code display mode, a code corresponding to the combustion sequence stage is displayed.
The table below shows the displayed code and the corresponding stage in the sequence.

Display	Sequence	Description
– –	Standby	The start contact input is off
P1	Start check	Start check of this device and of the AUD300C
P2	Ignition trial	Ignition of the pilot burner
P3	Pilot only	Check to conform reliable pilot burner ignition
P4	Main trial	Ignition of main burner
P5	RUN	Flame monitoring after main burner ignition

● Flame voltage display mode

Flame voltage is displayed as 2 digits.
For example, if the 7-segment display shows 3.2, it means 3.2V.

Handling Precautions

- Even if there is no flame, the display usually shows about 0.2. This is caused by the characteristics of the circuit, and is not an error.

● Alarm code display mode

When lockout occurs, the display automatically changes to alarm code display, and the lockout sequence code and alarm code are alternately displayed.

Display	Alarm name	Description
E0	Start check alarm	The start check was not completed for some reason such as momentary power failure or part malfunction
E1	Interlock alarm	Interlock occurred
E2	False flame	A false flame such as a remaining flame was detected
E3	UV alarm	A flame was detected even though the shutter output was off
E4	Ignition failure	No flame was detected at the completion of the ignition trial
E5	Flame failure	A flame failure occurred in the following sequence: • Pilot only • Main trial • RUN

Handling Precautions

- Pressing the [DISP] switch is while an alarm code is displayed, the flame voltage is displayed.
- To pressthe [RST] switch when a lockout occurs, the display mode returns to former mode.

● Event code display mode

When the mode changes to event code display mode, the event codes that have occurred are displayed in turn. For example, when the A1, A2 and A7 event have occurred, 7-segment display shows A1 → A2 → A7 → A1 by turns.

Display	Event name
A1	Ignition delay
A2	Shutter cycle count upper setting value
A3	Shutter cycle count lower setting value
A4	Operation time for event upper setting value
A5	Combustion time for event upper setting value
A6	Combustion count for event upper setting value
A7	Flame voltage upper value
A8	Flame voltage lower value

● LED display

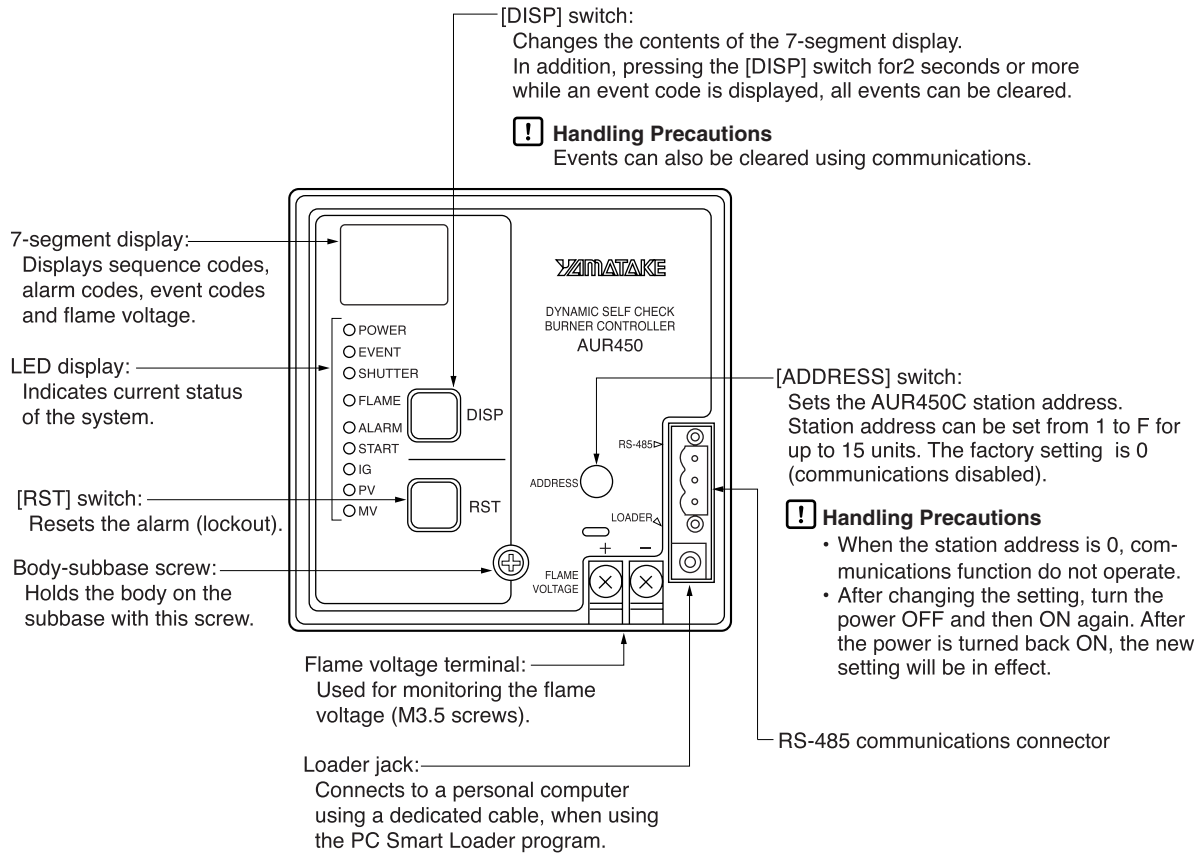
Name	Color	Description
POWER	Green	Lights up during the power is supplied.
EVENT	Orange	Lights up when an event occurs.
SHUTTER	Green	Lights up while the shutter is closing.
FLAME	Green *	Lights up while a flame is detecting.
ALARM	Red	Lights up when is an alarm is detected.
START	Green	Lights up when the start contact circuit is closed, and goes off when an alarm is detected.
IG	Green	Lights up while the ignition transformer is outputing.
PV	Green	Lights up while the interrupted pilot valve opening outputing.
MV	Green	Lights up while the main valve opening outputing.

* The LED light changes to green, orange or red based on the flame voltage level. If no flame is detected (K6 OFF), the LED is OFF.

Flame voltage level *	Color	Name	Address	Address (hexadecimal)	Data
2.5V or more	Green	Green FLAME LED light level	7070W	1B9E	25
1.6V to 2.4V	Orange	-	-	-	-
1.5V or less	Red	Red FLAME LED light level	7071W	1B9F	15

The flame voltage level and data shown are the factory settings.

■ Names and functions of operator panel components



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YAMATAKE

Specifications are subject to change without notice.

Yamatake Corporation
Advanced Automation Company

1-12-2 Kawana Fujisawa
Kanagawa 251-8522 Japan

URL: http://www.yamatake.com

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